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THE  
**RAILWAY MAGAZINE,**

AND

**Annals of Science :**

CONTAINING

**COPIOUS ACCOUNTS OF ALL RAILWAYS**

**AT HOME AND ABROAD;**

**NOTICES OF INVENTIONS, AND SCIENTIFIC DISCOVERIES.**

**BY JOHN HERAPATH, ESQ.**

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**VOL. II. NEW SERIES.**

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**LONDON:**

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**1837.**

# CONTENTS TO VOL. II. NEW SERIES.

## No. XI.

	Page
On the Throttling of Steam in Locomotive Engines, by the Editor	1
Notices of Railway Bills for the ensuing Session of Parliament, by John Thompson, Esq.	8
Sheffield, Ashton-under-Lyne, and Manchester Railway; Mr. Vignoles and Mr. Locke's Reports	12
On Axle-tree Friction, by "Mechanicus."	24
Sir John Rennie's Report on the Birmingham Railway	26
Harwich Railway	34
Cheltenham, Oxford, and Tring Railway	40
On the Habitudes of Iron and Steel, rejoinder of "C." to Mr. Maugham	45
On the Utility of Aerostation, by the Editor	51
Russian Railroad	52
London, Rochester, and Chatham Railway	54
Lecture on Railways	55
New Plan of Bricks for Chimneys, by Lewis Gompertz, Esq.	60
Scientific and Miscellaneous Intelligence	61
Review of Books	68
Progress of Railway Works	69
Railway Notices	73
Foreign Railroads	74
Share List	78

## No. XII.

On the Commercial Laying out of Lines of Railway, by the Editor	81
On Ventilating and Lighting Tunnels, by J. Walker, Esq., F.R.S.L. and E.; Pres. Inst. C.E.	86
Lecture on Railroads	90
On the Influence of Artificial Rarefaction and Condensation on some Diseases, by "A Subscriber."	94
Insurance Companies, by "A Father."	95
Railways to Brighton, by Wm. Tate, Esq., C.E.	97
Table of the Length and Cost of the Canals and Railroads in the United States of America	100
Proposed Improvement in Railway Tunnels, by Henry Booth, Esq., Treasurer, &c., of the Liverpool and Manchester Railway	102
Suggestions on Steam Navigation, by John Moore, Esq.	105
Upper Works of Railways, by Charles Vignoles, Esq., C.E., &c., &c.	107
Extract from a Letter to the Editor of the Railway Magazine	112
Oxford and Tring Railway, by a Tring Shareholder	114
Oxford and Tring Line	116
Experiment on the Interference of Light, by the Editor	117
What will Parliament do with the Railways? by the Editor	118
Scientific and Miscellaneous Intelligence	122
Review of Books	128
Progress of Railway Works	132
Railway Notices	133
Foreign Railways	140
Share List	142

# CONTENTS.

iii

## No. XIII.

	Page
On some points connected with the Principles of Locomotion, Assistant Engines, &c., by the Editor	145
Table of the Number of Working Days and Hours for every Month in the Year, for Public Works, by Charles Vignoles, Esq., C.E., and F.R.A.S., &c.	151
Estimate of Time occupied in the Execution of Earth Work, with special Reference to the Formation of Railroads, by William Tait, Esq., C.E.	152
Mismanagement of the Madras Military Fund, by "Omicron"	155
Experiments with Heated Metals, by "H."	160
M. Pambour's Rule for Calculating Friction, by "A Novice"	161
Practicability and Advantage of employing Steam of great density, ex- pansively, in Locomotive Engines, by "W. G. A.," Esq.	168
Kent Railway, and the Parliamentary Inquiry, by the Editor	167
Scientific and Miscellaneous Intelligence	168
Review of Books	175
Progress of Railway Works	178
Railway Notices	190
Parliamentary Proceedings	204
Share List	206

## No. XIV.

On the resistance of Locomotives in use on Railroads, by M. de Pambour, with notes by the Editor	209
On the Practicability and Advantage of employing Steam of great density in Locomotives, by "W. G. A.," Esq.	214
Duplicate Tunnels, by Mr. H. Rowley	219
Conspectus of the Traffic on the Liverpool and Manchester Railway, for six years	220
Cheltenham, Oxford, and London Railway, by "Anti-Humbug"	224
Railway Reports.—Birmingham, Bristol, and Thames Junction	225
Bristol and Exeter	229
York and North Midland	234
London and Southampton	236
North Midland	239
Great North of England	241
Birmingham and Gloucester	243
First Report of the Commissioners for Ireland	246
Medical Reports on Tunnels, with Notes by the Editor	257
Scientific and Miscellaneous Intelligence	263
Review of Books	269
Railway Notices	271
Parliamentary Proceedings	276
Share List	278

## No. XV.

On the fuel of Steam-Engines, by M. Cordier, translated from the French, as read before the Academy of Sciences	281
The Maryport and Carlisle Railway, by "J. R. A."	286
Memoir on the Calculation of High-Pressure Steam-Engines, by M. Pambour, read before the Academy of Sciences	290
Avery's Rotary Engine, by the Editor	300
Demonstrations of Dr. Pell's Theorems, by "J. J."	302
Theorem in general Differentiation and Integration, by the Editor	303
Midland Counties Railway	303
A Question relative to Mechanical Economy, of High-Pressure Steam- Engines, by "Nauticus"	307
Extract from a Letter to the Editor	308

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	Page
"Royal Society and Mr. Herapath" [The private Correspondence that caused the Discussion which ended in the Resignation of Sir Humphry Davy]	309
Railway Reports.—London and Croydon	313
Thames Haven	319
Scientific and Miscellaneous Intelligence	321
Railway Notices	329
Parliamentary Proceedings	339
Obituary	341
Share List	342

## XVI.

Calculations of the effects of the Atmosphere in resisting a Railway Train, by the Editor	346
Light for a Diving Bell, by Wm. Maugham, Esq.	354
Railway from Hull to Selby, by a Shareholder	355
Life Insurances, by Slow-and-Sure	365
Improved Canal Lock, by Joshua Field, F.R.S., V.P., Inst. C. E.	366
Suggestions on the Standing Orders of the House, by the Editor	370
On Proceedings in Parliament on Private Bills, more particularly Railway Bills	374
Report on the Cheltenham and Great Western Union Railway	376
First Report from the Select Committee on the Deptford and Dover Subscription List	380
"Royal Society and Mr. Herapath." [The private correspondence which terminated in the expulsion or forced retirement of Sir Humphry Davy from the Presidency of the Royal Society.]	389
Scientific and Miscellaneous Intelligence	394
Review of Books	400
Railway Notices	405
Parliamentary Intelligence	414
Share List	416

THE  
RAILWAY MAGAZINE;

AND

*Annals of Science.*

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No. XI.

JANUARY, 1837.

NEW SERIES.

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*On the Throttling of Steam in Locomotive Engines.* BY  
THE EDITOR.

RAILWAYS and the application of locomotive engines to them, notwithstanding what has been done, still constitute a subject, on many points of which our knowledge is imperfect and limited. It is not that the subject in a scientific sense is difficult; it is that men's minds are not yet trained to that course of investigation required for a correct understanding of the matter in all its various bearings. Hence the extraordinary notions maintained by Professor Mosely and Dr. Lardner at the British Scientific Association, described in No., VIII., pp. 319, &c.; hence too the erroneous impressions we have all had with regard to the actual danger of high velocities on curves of small radius, alluded to in our last No., p. 410; and hence also the many errors committed in the otherwise excellent works of Wood, Pambour, &c. The fact is we are proceeding over a new and pathless country, without, in a great measure, our usual guides, experiments. If therefore we wander a little on one side of the true and legitimate course, it is somewhat excusable, and our sins in this respect should not be visited upon us too severely.

Of all subjects connected with locomotion, there are few probably of greater importance, and on which engineers have made greater mistakes, than that of feeding the cylinders with steam.

"Experience," says M. Pambour, p. 243 of Weale's English translation, "has fixed the diameter that must be given to the steam pipes, and would quickly give notice if it were not observed." "Experience" is certainly an authority to which every wise man immediately bows; and when its name is used in this positive way it deters

B

## 2 THROTTLING OF STEAM IN LOCOMOTIVE ENGINES.

most of us from further inquiries. Experience however, like the Pagan deities, speaks in a language that every man cannot always rightly interpret, and M. Pambour himself seems here sadly to have misconstrued her symbols: "For," says he, "if it should happen, for instance, that an engine running with all its speed, should still emit steam through its safety-valve, that would be a proof that the area of the passage is too small for the quantity of steam the boiler is able to generate." Now I perfectly agree with M. Pambour, that if the steam pipe was beneath certain dimensions, the superabundant steam the boiler would generate, must pass off through the safety valve when the pistons are rapidly at work; but this is no proof that the pipe is sufficiently large to furnish the cylinders with all the steam the boiler could economically supply them with. Engines work with the greatest economy when the pressures in the cylinder and boiler approach the nearest possible to an equality, that is when there is the least interruption to the passage of the steam from the latter to the former. Let us for example suppose that the engine is at work, and that the pressures in the cylinder and boiler are equal, and much under that needed to raise the safety valve, which is generally the case. Then if we imagine the steam pipe to be of half the dimensions only, one half only of the steam can pass through in the same time, under the same circumstances. Consequently the action on the pistons must be less, and the temperature and pressure in the boiler greater; nevertheless the pressure may not be sufficient to raise the safety valve. Here then would be a case in which the steam would not blow off, and yet it is actually throttled; that is, a case in which the safety valve would not make the complaint M. Pambour declares it would, of being too small.

But what would follow? If the pressure in the boiler increases, the temperature too must increase. Consequently the difference between the temperatures of the fire and boiler would be less, between the temperatures of the boiler and surrounding bodies greater; and hence the communication of heat from the fire to the boiler would be diminished, the waste by conduction and radiation, and the danger of bursting increased, while the work performed might actually be less. And all this would happen from too small a steam pipe, without the safety valve giving the least indication of its being so.

We maintain, and experience and common sense prove it, that there cannot be too free a communication between

the boiler and cylinders. We quite agree with M. Pambour, that "between two engines, perfectly similar in other respects, there must be an advantage in favour of that one in which the steam pipes have a more considerable area;" but it is by no means "clear," nay, it is positively wrong, as I have shown, "that as soon as we have attained a diameter sufficient for the passage of all the steam that the boiler is able to generate, at the greatest speed with which the engine is required to go, nothing further is to be gained by augmenting still more the diameter." In my opinion two great objects are to be gained—greater safety and more economy. All that we want is the power of husbanding our steam occasionally for emergencies, which is obviously to be had by the throttling valve. As to making the induction pipe just large enough, under circumstances, to prevent the safety valve from being raised is very injudicious and injurious. But I shall endeavour to show this clearer by calculation. According to the experiments of Gay Lussac, the specific gravity of aqueous vapour is five-eighths of that of dry atmospheric air, at the same temperature and elasticity. Therefore by the theorem, p. 25 of our Vol. I., and by what we have shown, p. 90, the velocity with which steam will rush into a vacuum will be

$\sqrt{\frac{8}{5}} = 1.2649$  times the velocity of sound in an atmosphere

of the same temperature. Again by the table, p. 80, the temperature of the steam at a pressure of 45lbs. per inch, is 275° Fahr. At this temperature the theorem before alluded to will give the velocity of sound in dry air at about 911 miles an hour. Consequently the velocity with which steam will rush into a vacuum of this temperature, that is, corresponding to a pressure of 45lbs. to the inch, will be about one fourth greater, or 1140 miles per hour.

Hence if a surface was retreating through the steam pipe at the rate of 1140 miles an hour, the pressure in the boiler being 45lbs. to the inch, the steam would just follow it up, but would not press it. So likewise if the velocity of the piston in miles per hour, was to 1140, as the square of the diameter of the steam pipe to the square of the diameter of the cylinder, the whole power of the steam would be exerted in following the piston, but it would not drive it. Now in general the diameters of the cylinders are about  $3\frac{1}{2}$  times those of the steam pipes in the Liverpool and Manchester locomotives. Therefore the ratio of the areas, or of squares of the diameters, is about that of  $12\frac{1}{4}$



#### 4 THROTTLING OF STEAM IN LOCOMOTIVE ENGINES.

to 1. Consequently, a single piston travelling in its cylinder at the rate of  $\frac{1140}{12\frac{1}{4}} = 93$  miles an hour, would just avoid the pressure of the steam following it. And if there were two cylinders and only one pipe, this would happen at  $46\frac{1}{2}$  miles an hour for either of them ; or to have an easier correspondence with the pressure, say at 45 miles per hour.

Every mile an hour, therefore, that the pistons travel in their cylinders under such circumstances, the pressure of them would be about 1 lb. less than the pressure in the boiler. This we presume must be a matter of some consequence, when we know that in high velocities the relative velocities of the pistons are near 10 miles an hour. Had the steam pipe been equal in diameter to the cylinder, the relative velocity of the piston must have been upwards of 12 times as great to produce an equal loss of pressure.

This will be the best answer to M. Pambour, whether "nothing further is to be gained by augmenting the diameter" of the steam pipe.

I have not given the preceding views in a mathematical form, but have followed a particular calculation. However, there is no difficulty in the more general mathematical part, and perhaps it may be more satisfactory.

For instance, suppose  $P$  the pressure in lbs. per inch in the boiler, and let  $\frac{22}{15} V$  be the velocity of sound found from the theorem  $p$  25, the temperature being that corresponding to  $P$  in the table, p. 80 of Vol. 1. Then  $V$  will be the said velocity of air in miles per hour, and  $1.265 V$  that of aqueous vapour or steam, or the velocity with which it rushes into a vacuum. And if  $r$  to 1 be the ratio of the diameter of the cylinder to that of the steam pipe,  $\frac{1.265 V}{r^2}$  will be the rate at which the steam can follow the piston without pressing on it, or the miles per hour the piston must travel in the cylinder to avoid the pressure  $P$ . Consequently  $\frac{1.265 V}{r^2 P}$  will be the velocity of the piston, to reduce the pressure on it one pound per inch less than the pressure  $P$  in the boiler. This supposes there is a steam pipe to each cylinder; if there be but one to both the velocity will be one-half or  $\frac{.6325 V}{r^2 P}$

Again, if  $m$  be the miles per hour the engine travels,  $R$

the radius of the wheel in feet,  $S$  the length of the piston stroke also in feet, and  $\pi = 3.14159$  the circumference of a circle whose diameter is unity, we shall have for the velocity of the piston in the cylinder in miles per hour  $\frac{Sm}{\pi R}$ .

Therefore if  $L$  be the pounds lost per inch

$$\frac{.6325 \, V L}{r^2 P} = \frac{Sm}{\pi R} \text{ and } L = \frac{m S r^2 P}{.6325 \pi R V} \dots (1)$$

If we divide both sides of this equation by  $P$  we shall have the proportional loss of pressure. Other things being alike this proportional loss will be directly as the speed of the engine, and therefore less, the less the speed. Consequently, though an engine has more work to do up hill, it does it more economically, in proportion, than it does on a level where its speed is so much greater. It for like reasons carries heavier loads with more economy than lighter.

Since  $.6325 \pi = 2$  nearly, and  $V$  is about 900 and varies but little for a considerable variation in  $P$ , we have for finding the proportional loss of pressure the following

**Practical Rule.**—Multiply the speed of the engine in miles per hour, by the ratio of the areas of the cylinder and steam-pipe, and the length of the stroke or twice the length of the crank in feet. Divide the product by 1000 times the diameter of the working wheels, and the quotient diminished by one tenth of itself will be the proportional loss of pressure arising from throttling the steam.

If the loss of pressure be required in lbs. per inch, we have only to multiply the proportional quantity just found by the pressure in lbs. per inch in the boiler.

**Example.**—Suppose the pressure in the boiler 40 lbs. to the inch, the length of the crank 9 inches, or  $\frac{3}{4}$ ths of a foot, the diameter of the wheel 4 feet, the diameter of the cylinder three times that of the induction-pipe, and the velocity of the engine 30 miles an hour; query the proportional loss of power by throttling in the induction or steam-pipe. In this case the areas of the cylinder and pipe are as 9 to 1.  $30 \times 9 \times 1\frac{1}{4} = 405$ ; and  $1000 \times 4 = 4000$ . Dividing the former product by the latter, we have .10125, which diminished by .01012 is .09113, or rather better than 9 per cent. loss of the whole pressure.

This I have reason to believe is a very moderate estimate of the loss, and much within what occurs in practice, as the

following experiment, which I think I have before alluded to, will substantiate.

On Monday the 14th of April 1834, I left Liverpool on a train of 5 coaches 10 tons 10 cwt., with 51 passengers 3 tons 16 cwt., a horse waggon 2 tons 2 cwt., engine 8 tons 10 cwt., and tender 3 tons 10 cwt., or in all about 28 tons 8 cwt. Previous to ascending the plane we had a velocity of 31·6 or 32 miles an hour, but in little more than half a mile we sunk to a uniform velocity of 10·2 miles per hour, which velocities I ascertained by accurate observations of the times of passing the quarter mile posts and the method of differences. Our pressure in the boiler before beginning the plane was 40lbs. to the inch, and in the incline 50, as given to me by the engine-man. This plane ascends 1 in 96, or 55 feet per mile. My object being merely to observe the effect of momentum, unluckily I did not get either the name of the engine or the dimensions of it; nor did I think of measuring the front area of the carriages, or pay any nice attention to the force or direction of the wind; but I believe it was N.E. nearly and a middling breeze. All that I distinctly recollect was suffering excessively from the cold on the top of the train, it being very cold weather and early in the morning. Now if there was 40 square feet of resisting surface, which I am informed is about that of the Liverpool passenger trains, our table page 95, Vol. I. will give about 19·6 tons for the additional load due to the resistance of a still atmosphere when the velocity is 32 miles an hour. On the level before beginning the hill the load may hence be reckoned  $28·4 + 19·6 = 48$  tons. At 10·2 miles an hour the resistance will augment the load by 2 tons. And by the same table the exertion of the engine corresponding to a rise of 55 feet a mile is 3·9 times what it is on a level. Therefore the actual load the engine drew up the incline was  $28·4 \times 3·9 + 2 = 112·8$  tons. Hence the exertion of the engine in the incline, was to that at the foot of it, as 7 to 3; and the 40lbs. pressure, if there had been no throttling of the steam, ought to have risen to 94 lbs.; or on the level the 50 lbs. in the hill ought to have required only 21·4 lbs., little better than one-half of what it actually was.

But, perhaps, it will be objected that we have allowed nothing for the counter pressure of the atmosphere on the piston, which is 15lbs. to the inch. Be it so. Then if we take 15 from 50 it will leave 35, which diminished in the ratio of 7 to 3 will be 15, that is 10 lbs. less than the actual pressure 40 diminished by the pressure of the atmosphere

or 15 lbs. So that, supposing no throttling in the slow motion up the hill, there is nevertheless a pressure of 10 lbs. per inch throttled by the swift motion on the level, that is, more than double our previous computation.

I have long suspected that the smallness of our induction pipes has been one of the great causes of the inefficiency in our locomotives in high velocities, and of one or two other phenomena observed in locomotive transit hitherto unexplained. For example, Mr. Wood\* has shown that large wheels work with more economy and faster than less. Now I candidly confess I do not see any fair reason for this fact, unless it be the one I allude to. If there be any, I should be glad to see it assigned. According to the views I have taken, the matter may be thus shown.

The economy alluded to is in fuel and time. Now it is evidently immaterial as to the consumption of fuel, whatever be the tension of steam at which the engine works, if the fire be the same. The object is to traverse a given distance in a less time; and exactly as the time saved is, so is the saving of fuel. If, therefore, in (1) we set aside all considerations of pressure, by making  $\frac{L}{P}$  a constant quantity, we obtain,

$$m \text{ as } \frac{R V}{S r^2}, \text{ or, as } V \text{ is nearly constant, as } \frac{R}{S r^2}. \quad (2)$$

Therefore, all other things alike, *the miles per hour travelled by the engine will be as the radius of the working wheels directly, the length of the stroke inversely, and the ratio of the area of the cylinder to that of the induction pipe also inversely.* But if my memory is correct, Wood has actually recorded a series of experiments, in which it is established, that with the same engine and load, but different working wheels, the time or fuel is inversely as the diameter of these wheels;—facts which I believe have hitherto received no satisfactory explanation, and have been regarded almost as paradoxical, but which by our analysis are now accurately accounted for on a principle I apprehend no one has dreamed of referring them to, namely, the throttling of the steam by the induction pipe.

The same consequence thus drawn from an enlargement of the diameters of the wheels, the theorem likewise gives from an increased area of the steam pipe.

Another argument will here appear in favour of increasing

\* I have not now this work before me, and cannot therefore go into the details.

the gage of the rails, which is indeed the one I alluded to in p. 353, Vol. I. as being important; and I hope, from the bearing it has on the improvement of engines and railways, my readers will not think I have rated it too highly.

Before I conclude this paper, I must beg leave to notice an error in M. Pambour's work, which may occasion considerable embarrassment to those who may be led to consider this part of the subject, and may not be able readily to discover the fallacy of that ingenious author's reasonings.

M. Pambour, in p. 139 of the English translation, endeavours to show, that when the engine has attained the limit of its power, or, as we should express it, its maximum velocity, the pressures in the cylinder and boiler are equal; whereas, according to our view, they are then the most unequal. "In fact," says he, "the pressure in the cylinder cannot be less than in the boiler; for, if it were, by diminishing the velocity, which is the only obstacle to the establishment of an equilibrium of pressure between the two vessels, one might give to the steam time to rise in the cylinder until it would equal the pressure in the boiler, and then the effect would be augmented. *That is to say, the engine might draw a greater load, provided its velocity were diminished.*" M. Pambour must here evidently be labouring under some great misapprehension; for who does not know, that the lighter the load, *ceteris paribus*, the greater the velocity? Indeed, he himself says, p. 192, "We found above the expression of the load an engine is able to draw at a given velocity; and the less the velocity, the more considerable may be the load."—EDITOR.

*Notices of Railway Bills for the ensuing Session of Parliament.* By JOHN THOMPSON, Esq.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

*Harwich Railway Office, 26, Austin Friars,  
Dec. 20, 1836.*

SIR,—I SEND for insertion in the next number of your Magazine—if you can spare room for it—a list of the Notices which have been given of intended applications to Parliament for Railway Bills in the ensuing Session. I regret I have not been able to spare time sufficient to make it more complete as regards the capital required for the various new Lines, but in other respects it is correct, unless, perhaps, I may have given the title of one or two of them inac-

curately, owing to the Notice not having been *headed*, and in those cases I have endeavoured so to describe the Line as to prevent its being mistaken. It appears that 118 Notices have been given, of which 85 are for new Lines; 28 for extensions, deviations, or branches; 4 for enabling Companies to raise further sums of money; and 1 for enlarging the time named in the Act for the completion of the Railway.

I am, Sir, yours, &c.

JOHN THOMPSON.

1. Alverstoke and Portsmouth Junction.—New line and branch.
2. Ardrossan and Kilmarnock.—New line.
3. Bath and Weymouth Great Western Union.—New line.
4. Beccles, Bungay, and Harleston.—New line.
5. Belfast and Hollywood.—New line.
6. Birmingham, Bristol, and Thames Junction.—Extension and deviation. Capital, 75,000*l.* additional.
7. Birmingham, Dudley, Stourbridge, and Wolverhampton.—New line.
8. Birmingham and Derby.—Deviations and branch.
9. Birmingham and Gloucester.—Branches to Worcester, Tewkesbury, and the Great Western Union Railway.
10. Bishop-Auckland and Weardale.—New line.
11. Bolton and Preston.—New line.
12. Brecon and Merthyr-Tydvil.—New line.
13. Brighton and London. (Cundy's).—New line. Capital, 800,000*l.*
14. Bristol and Gloucestershire.—Extension to the Cheltenham and Great Western Union.
15. Cambridge and Bury St. Edmund's.—New line.
16. Canterbury and Whitstable.—To raise a further sum of money.
17. Central Kentish and Sandwich Harbour.—New line and branch. Capital, 1,500,000*l.*
18. Cheltenham and Great Western Union Branch.—New line from Coldpool Farm, in the county of Gloucester, to join the Great Western Railway at Milton, in the county of Berks.
19. Cheltenham and Oxford, and London and Birmingham.—New line. Capital, 1,400,000*l.*
20. Chester and Grand Junction Union.—New line.
21. Chester Junction.—New line.
22. Chester and Woodside.—New line.
23. Christchurch and Abergavenny.—New line.
24. City of London and Richmond.—New line and branch to join the Birmingham, Bristol, and Thames Junction Railway. Capital, 1,000,000*l.*
25. Clarence and Stockton, and Darlington Union.—New line.
26. Commercial (London and Blackwall).—Extension to the East India House, and deviations.

27. Cork and Cove.—New line.
28. Cork and Passage.—New line.
29. Devizes and Melksham Great Western Branch.—New line.
30. Doncaster, North Midland, and Goole.—New line. Capital, 350,000*l*.
31. Drogheda, to Kells, in the county of Meath.—New line.
32. Dublin and Drogheda.—Deviations and alterations.
33. Dundalk Western.—New line.
34. Durham Junction.—Extension and branches.
35. Durham and Sunderland.—Deviations and branch.
36. Eastern Counties.—Deviations and alterations.
37. Edinburgh and Glasgow.—New line. Capital, 65,000*l*.
38. Edinburgh, Haddington, and Dunbar.—New line and branches.
39. Glasgow, Paisley, and Greenock.—New line and branches.
40. Glasgow and Newtown.—New line.
41. Glastonbury and Bruton (Somerset).—New line and branches.
42. Gloucester and Bristol.—New line from the Cheltenham and Great Western Union Railway to Bristol.
43. Gloucester and South Wales.—New line.
44. Grand Connection.—New line and branches.
45. Grand Junction.—Deviations and alterations.
46. Do. Do.—New line from Stafford to the London and Birmingham Railway at Rugby.
47. Grand Northern Trunk (Ireland).—New line.
48. Great Central Irish.—New Line and branches. Capital, 2,000,000*l*.
49. Great North of England.—Deviation and extension.
50. Great Leinster and Munster.—Extension to Limerick. Capital, 1,000,000*l*.
51. Great Western.—Extension to Paddington.
52. Do. Do.—Deviations and alterations.
53. Hampshire and Wiltshire Junction.—New line.
54. Hartlepool and Clarence Union.—New line.
55. Harwich.—New line, to join the Eastern Counties Railway at Colchester. Capital, 220,000*l*.
56. Hull, Lincoln, and Nottingham.—New line. Capital, 1,000,000*l*.
57. Hyde Park and Richmond.—New line. Capital, 500,000*l*.
58. Ipswich and Bury.—New line. Capital, 300,000*l*.
59. Irish Eastern and Western.—New line and branch.
60. Johnston and Ardrossan.—Branches, &c.
61. Kent (London and Dover).—New line. Capital, 200,000*l*.
62. Kilmarnock.—Deviations and alterations.
63. Kingstown and Bray.—New line. Capital, 200,000*l*.
64. Lancaster and Preston Junction.—New line.
65. Leicester and Swannington.—To enable the Company to raise a further sum of money.
66. Liverpool and Manchester.—To enable the Company to raise a further sum of money.

67. London and Brighton (Stephenson's).—New line. Capital, 1,000,000*l*.
68. London and Brighton (Rennie's).—New line. Capital, 800,000*l*.
69. London and Brighton (Gibbs's).—New line. Capital, 900,000*l*.
70. London and Croydon.—Branch to Epsom.
71. Londonderry and Enniskillen.—New line and branches.
72. London, Exeter, and Falmouth.—New line. Capital, 2,500,000*l*.
73. London, Ramsgate, and Dover.—New line.
74. London, Rochester, and Chatham.—New line. Capital, 200,000*l*.
75. London and Southampton.—Deviations and alterations.
76. London, Ware, and Hertford.—New line, to join the Northern and Eastern Railway.
77. Manchester, Bolton, and Bury Canal Navigation and Railway.—New line.
78. Manchester and Leeds.—Deviations and alterations.
79. Manchester, Leeds, and Goole.—New line and branch.
80. Manchester and Rickerscote.—New line, to join the Grand Junction Railway at Rickerscote, in the county of Stafford.
81. Manchester and Tamworth.—New line, to join the Birmingham and Derby Junction at Tamworth.
82. Maryport and Carlisle.—New line.
83. Midland Counties.—Deviations, extension, and branch.
84. New South Durham (or Weardale Junction).—New line. Capital, 100,000*l*.
85. Northern and Eastern.—Extension from Cambridge to York.
86. Norwich and Leicester.—New line.
87. North Midland.—Deviations and branches.
88. Oxford and Great Western Union.—New line.
89. Oxford and London and Birmingham Union.—New line.
90. Penryn and Helston.—New line.
91. Polloc and Govan, and the River Clyde.—Deviations and alterations.
92. Portsmouth Junction.—New line. Capital, 300,000*l*.
93. Preston and Wyre.—Deviations and alterations.
94. St. George's Harbour and Railway.—New line.
95. Salisbury, Romsey, and Southampton.—New line. Capital, 300,000*l*.
96. Sheffield, Ashton-under-Lyne, and Manchester.—New line. Capital, 1,000,000*l*.
97. Sheffield and North Midland.—New line.
98. Slamannan.—Branch.
99. South-Eastern.—Deviations and alterations.
100. South-Eastern, Brighton, Lewes, and Newhaven.—New line. Capital, 1,200,000*l*.
101. South-Eastern, Canterbury, Ramsgate, and Sandwich.—New line.



102. South-Eastern and Maidstone.---New line.
103. South Midland Counties.---New line from the London and Birmingham Railway, to join the Midland Counties Railway at Great Wigstowe, in the county of Leicester.
104. Southwark and Battersea.---New line.
105. South-Western.---New line, to connect the London and Southampton with the Bristol and Exeter Railway. Capital, 2,000,000*l*.
106. Stirling.---New line.
107. Stourbridge, Dudley, and Birmingham.---New line.
108. Taff Vale.---Deviations and branches.
109. Tilbury Fort and Thames Haven.---New line.
110. Truro, Redruth, and Penzance.---New line and branches. Capital, 550,000*l*.
111. Union.---New line, to connect the Clarence and Hartlepool Railway.
112. United Armagh and Dublin, and Drogheda (Inland).---New line.
113. United Kingdom General.---Any lines, if with consent of owners.
114. Warwick, Leamington, to join the London and Birmingham near Coventry.---New line.
115. Westminster Bridge, Deptford, and Greenwich.---New line and branches. Capital, 700,000*l*.
116. Whitby and Pickering.---To enable the Company to raise a further sum of money.
117. Wishaw and Coltness.---To enlarge the time for completing Railway.
118. York and North Midland.---Deviations and alterations.

*Sheffield, Ashton-under-Lyne, and Manchester Railway.*

WE this month present our readers with the plan of a line of Railway between the two important manufacturing towns of Sheffield and Manchester, embracing Ashton-under-Lyne, &c. Though convinced of the importance of a railway communication between these places, and quite satisfied, if a working line could be made at any reasonable expense, it would pay well, we confess we have looked to it with "hopes faint and few," from the well-known difficulties of the country. However we are glad to find that there is no less authority than that of Mr. Vignoles and Mr. Locke, to prove that we have been mistaken; and that though it is not the best working line in the kingdom, it is far better than many which are considered quite passable, and are called good.

The worst feature we like is the tunnel. We fancy our-



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selves great connoisseurs in railway beauty, and think tunnels, like small-pox pittings in a pretty face, always detractive. But there are some who think otherwise; we do not allow them to be any judges. However, nature has here set up a barrier which defies any line to be constructed without a sad "great bore," but she has kindly placed those there whose industry and commercial enterprise will bore through anything; aye, and make it pay too. But for this, the profit part of the business, we must refer to the prospectus on the wrapper, and for a detailed description of the line to the reports below; simply adding, that we shall be glad to see the railway completed, and all such lines, connecting great commercial towns, throughout the country.

EDITOR.

MR. VIGNOLES' REPORT.

*To the Committee for promoting the Sheffield, Ashton-under-Lyne, and Manchester Railway.*

GENTLEMEN,

THE project for a railway from Sheffield to Manchester, with a branch through Ashton-under-Lyne to Stayley-Bridge, suitable for the transit of locomotive engines throughout, which I had the honour of submitting to your consideration at the public meetings held in Sheffield and Manchester early in January last, having been adopted by you, you were pleased to order, in the latter end of May, that separate surveys of the line should be made by Mr. Locke and myself; which having been accomplished, and having been under your consideration, were referred back to be revised by us jointly, in order to fix from the various sections examined and laid down on our respective plans, one line combining the greatest advantages in all respects, and in which we could concur.

As Mr. Locke coincided fully with me in the principles I had all along laid down, the differences in detail were soon adjusted, and the result will appear in the Parliamentary maps and sections in course of preparation by me; and the direction of the railway, together with the inclinations or gradients thereon, will be described in the course of this report.

I feel much satisfaction in reporting to you, that, except in detail, no variation has been made from my designs originally laid before you, and that the most elaborate investigations separately made, confirm the line by the valleys of the rivers Dun and Etherow to be the most advisable and the best directed for crossing the great ridge dividing Yorkshire from the counties of Lancaster and Chester; presenting in its details the best natural section the country affords; and it is necessary to bear in mind that no railway communication between the two important towns of Sheffield

and Manchester can be laid down which will not have to encounter the great natural obstacle of this ridge.

I have so projected the terminations, as to connect most advantageously with the contemplated railways. The principle of uniformity of inclinations, or rate of ascent and descent, has been followed out as far as possible; while the branch line through Ashton-under-Lyne to Stayley-Bridge, is calculated to afford the largest amount of accommodation to those towns with favourable gradients, and at the smallest cost consistent with those objects, and considering the nature of the ground and property.

I must repeat, that the original leading principle I have kept in view was to obtain a locomotive line of railway; and in working this out, I have arranged that no slope shall exceed 44 feet per mile, or one in 120, a gradient upon which experience has proved that locomotive engines can travel upwards at reasonable speed, with moderate loads, and downwards with perfect security.

To effect this object through the district selected, I have had recourse to works of engineering of a character well justified by the important advantages of this railway; and after a year's deliberate consideration, I am more and more satisfied of the entire feasibility of the construction and of the well-working of the line, and also of the returns on the expenditure necessary to effect it, affording a very handsome profit to the Subscribers, while the local, and particularly the public benefits, will be very great.

Without the possibility of a rival establishment by land or by water, with advantages for local and general traffic and communication opened to sources, and to an extent hitherto excluded or limited; passing through and connecting places rich in mines and minerals, and abounding in commercial establishments, and offering a cheap and easy opening for the conveyance of grain from the agricultural to the manufacturing districts, it appears to me that few of the projects brought before the public present better opportunities for permanent investment, while the great advantages offered to, and the favourable views and opinions of the great majority of the landowners, including those of largest holding and most influence, and the indisputable public good to arise to all the towns connected, and to all the districts pervaded, almost ensure the success of the measure through the legislative ordeal.

In continuation of my remarks on the setting out of the line, I would observe, that the various curves have been studied so as to have them laid down from the largest radii which the country admits. There will in no place be a smaller radius than 66 chains, which is something less than one mile, being a set-off of one foot in 66, a curve which is now considered admissible on main lines. It is, however, only in a few places that it has been found necessary to verge on this limit of radius of curvature; generally the curves have upwards of a mile radius.

The railway will commence in Manchester, on the east side of

Store-street, near the London-road, and proceed in a straight course over several streets, crossing the river Medlock, and continuing nearly direct through the suburbs of Manchester, and then proceed towards the old Pottery Works, on the road to Gorton.

From the Gorton road the railway goes in an eastwardly direction up a small valley, to pass 20 feet under the Stockport canal; from whence, to the first crossing of the Ashton old turnpike road at the Fox Inn, some deep cutting is necessary. The line will recross this road at North-street (near the Guide bridge), where the branch to Ashton and Stayley Bridge is to go off. Passing close to the south of the Ashton canal, the main line crosses the valley and river Tame, at an elevation of 40 feet above the water; then passes over the Peak forest canal, and under the Dukinfield road, and bears away to the north of Dewsnap colliery, and forward passes between Mr. Ashton's house and the factories at Newton Moor, crossing Newton green. Proceeding into Godley Township, the line goes behind Mr. Turner's house, and further on through Bonnyfields farm, and will cross over the new turnpike road from Hyde to Mottram, south of the Olive Branch Inn, skirting the houses on Godley-hill, then proceeding to the head of the valley, will pass the Stockport old road, near the turn to Bottoms hall, in a deep excavation.

Crossing the wooded ravines in Hattersley, the railway keeps to the south of Harewood Lodge, and goes over the turnpike road, near the row of cottages there; and thence straight to cross the river Etherow (or Mersey) immediately below Best Hill Mill, or Broadbottom, at a considerable height, but where the valley is very narrow. A viaduct will be required here, for the construction of which most excellent materials will be found in a fine stone quarry, immediately abutting on the line of railway, and otherwise remarkably well situated for the purpose. Continuing its direct course, the railway will go close to the north of Upper Gamesley, and sweeping to the left, must cross Dinting Vale, at a great elevation. The viaduct and embankments here will be the most important works on the railway. At this point the line will be within three-fourths of a mile of Glossop. After passing Dinting Vale, the course of the line will be by Shaw and Mousley Farms, and farther forward will pass about midway between Hadfield and Padfield, and through the farm of Deep Clough, on a high but very short embankment. From Deep Clough to Torr Side, the earthwork is very inconsiderable; but on leaving Torr side to the north, another short but high embankment is requisite. Woodhead is left about a quarter of a mile to the north, and after running close along the stream of the Etherow to within a mile and a half of Saltersbrook, the entrance to the tunnel through the summit ridge commences. The tunnel, in order to ensure throughout the same a gradient of 20 feet per mile, or one in 264, is now extended to three miles in length, coming out again on the York-

shire side of the ridge at Dunford Bridge. The locomotive engines which must necessarily be purposely constructed to travel on the most prevalent steep inclinations, will pass readily and rapidly upwards through the tunnel, and the time of transit may be limited to ten minutes. Lamps will, of course, be affixed to the carriages while passing through the tunnel, as in the new passenger tunnel at Liverpool. Thus the time will scarcely be longer, and the accommodation quite as great, as at this establishment, which is found to give the greatest public satisfaction, and is not attended with any inconvenience. From the summit, a little beyond the east end of the tunnel, the railway will descend in one uniform slope to Sheffield, proceeding in nearly a due east course down the south or right bank of the valley, passing close under the town of Penistone. After crossing the Dun, the line will pass over the woods and grounds of Outhwait House. From about this point, any branch lines from the coal fields on the eastern side of the Wortley and Oxspring Ridge, may advantageously fall into the main line. After passing Outhwaite, the railway will curve round the great bend of the river north of the Mill-pond at Wortley Forge, and proceeding to the east of the Common, enter Wharncliffe Wood. The railway will proceed the whole length of Wharncliffe Wood, on the sloping face of the hill which it covers, and passing the deep, narrow ravine at its south-eastern extremity, will go close to the west of Oughtibridge Old Hall, and pass on the hill side, through Beeley Wood, and bend round to pass the new road from Sheffield to Penistone, close above the Wadsley Bridge toll bar. Continuing on, the line will go behind the house and grounds at Wardsend, then keep through Scraith Wood, and through the Old Park Wood, at a suitable level on the hill sides; then crossing Harvest-lane, and through the cluster of small gardens, will pass under the Barnsley-road, and behind the chapel at Bridge-houses, keeping below all the streets to the Nursery-grounds, where the descent of the railway from the summit will terminate, and whence it is proposed, by means of a viaduct, to carry the line across the Wicker, and across the river Dun, immediately below the confluence of the river Sheaf, into a vacant piece of ground close on the east of the Cattle-market, where the Sheffield Depot will be formed, and whence the proposed line to the southward from Sheffield may be advantageously extended. The elevation of the viaduct will be about 25 feet above the water-line of the basin of the canal, or lower, if it can be arranged without materially shortening the terminating piece of level of the railway between the Nursery-grounds and the Cattle-market.

The branch to Ashton-under-Lyne and Stayley-bridge will proceed out of the main line at North-street; cross the Hooley-hill-road, close to the Guide-bridge, and over the Ashton Canal there; then run parallel to the old road between Stockport and

Ashton, and entering the built-up part of the latter town, will cross under all the streets to Mill-lane. The gradient thus far will be horizontal or nearly so; but from Mill-lane a sharp rise for about 500 yards is necessary, to pass over the Dukinfield-road beyond the Old Manor House or Hall at Ashton. This mode of passing through the town of Ashton will afford the greatest amount of public accommodation there, and will not interfere with any of the factories, and with only one small warehouse, the other property being almost exclusively cottages. An excellent station may be made at any point between Mill-lane and the Dukinfield-road. After crossing the road, a short cutting carries the Railway through the Bank-top-hill; and for the rest of the way to the crossing of the river at Stayley-bridge Town, the gradient will be about one in 300, and with light earthwork. The terminus will be on the side of the Huddersfield Canal, near a principal street in Stayley-bridge, at an elevation of from 12 to 15 feet above the surface.

The length of the main line from Store-street, in Manchester, to the Cattle-market, in Sheffield, will be about  $40\frac{3}{4}$  miles, having about 18 miles of ascent from each town to the tunnel, which may be considered as comparatively level, (the descent however, being towards Manchester,) and with nearly horizontal terminations at each extremity of the Railway. The length of the branch-line will be about  $2\frac{1}{2}$  miles, viz.,  $1\frac{1}{2}$  miles to Ashton-under-Lyne, and one mile further to Stayley-bridge. The total distance from Store-street, in Manchester, to a central point in Ashton, being  $6\frac{1}{2}$  miles; and to the terminus in the town of Stayley-bridge, within  $7\frac{1}{2}$  miles.

The following is a list of the inclinations on the main line, and on the branch as finally laid down, and graduated on the Parliamentary Section.

*Gradients on the Main Line from Manchester to Sheffield.*

	Distance.	GRADIENT.	Elevation above the Sea in Feet.
	Miles.Ch.	LEVEL OR DATUM.	
Station at Store-street in Manchester . . . . .	0. 0	. . . . .	168
From Store-street to the outskirts of Manchester, and to where the line to Stockport and the South will branch off . . . .	0 54	9 ft. per mile, or 1 in 587	174
From the outskirts of Manchester to the Stockport Canal North of Gorton Factory . . . . .	2-00	30 ft. per mile, or 1 in 176	234
From the Stockport Canal to the Junction of the branch from Ashton and Stayley-bridge near North-st., near the Guide Bridge on the Ashton Canal .	2. 20	42 ft. per mile, or 1 in 125	328 $\frac{1}{2}$

c



From that Junction to the road in Dukinfield, immediately east of the Peak Forest Canal.	0.47	23 ft. per mile, or 1 in 230	342
From the Dukinfield-road to the Stockport Old-road in Hat-terley Township, near the turn to Bottoms Hall . . .	3.53	38 ft. per mile, or 1 in 139	481
From the Stockport Old-road to the Road from Stockport to Dinting Vale, at Upper Gamesley . . . . .	2.00	26½ ft. per mile, or 1 in 200	534
From Upper Gamesley to the Southwest entrance of the Tunnel through the Summit-ridge.	7.60	44 ft. per mile, or 1 in 120	875
Through the Tunnel, and a short distance further Eastward to the Summit . . . . .	3.32	20 ft. per mile, or 1 in 264	943
From the Summit to the edge of the Nursery-ground at Sheffield . . . . .	18.6	42 ft. per mile, or 1 in 125	184
From the Nursery-ground to the Sheffield Station and Terminus at the Cattle-market . . .	0.34	Horizontal.	184
Total distance . .	40.66	or 40½ miles.	

*Gradients on the Branch to Ashton-under-Lyne and Stayley-bridge.*

	Distance.		GRADIENTS. LEVEL OR DATUM.	Elevation above the Sea in Feet.
	Miles.	Ch.		
From the Junction with the Main Line at North-street, to the crossing of the Ashton Canal near the Guide-bridge .	0.5		40 ft. per mile, or 1 in 132	331
From the Ashton Canal to the commencement of the buildings on the outskirts of the Town of Ashton-under-Lyne . . . .	0.46		8 ft. per mile, or 1 in 660	335
From the outskirts of Ashton to Mill-lane, in the centre of the Town . . . . .	0.36		Horizontal	335
From Mill-lane to the crossing of the Road or Street leading from the upper part of Ashton to Dukinfield . . . . .	0.26		52½ ft. per mile, or 1 in 100	352
From Dukinfield to the Terminus of the branch in the Town of Stayley-bridge, adjoining the Huddersfield Canal . . . .	1.12		17 3 5 ft. per mile, or 1 in 300	372
Total distance . .	2.45			

In respect to the practical working of the Sheffield, Ashton-under-Lyne, and Manchester Railway, it will be, of course, necessary to have powerful locomotives, peculiarly adapted for travelling on the adopted inclinations. The daily accumulating experience of skilful mechanics, who are engaged in this department, and the knowledge acquired of the work done on the existing railways assure me, that there will be no doubt or difficulty in obtaining locomotive engines which will be able to travel with four or five passenger carriages, averaging eighteen or twenty passengers each, between the two great towns in about two hours and a half, or probably oftener in less time, which is at the rate of about twelve miles per hour on the ascent, and about twenty-five miles per hour on the descent. The trip from Manchester to Stayley-bridge may be always insured within half an hour, including a stoppage at Ashton, and if needful, another stoppage on the main line near Manchester.

In respect of goods, I conceive no difficulty need arise to prevent the heavy trains proceeding at a moderate speed, by arranging that the times of departure do not interfere with the regular passenger traffic; and both merchandize and coal might travel at night. I consider, that gross loads of sixty tons in one merchandize train, may pass between Sheffield and Manchester in about three hours and a half, or not exceeding four hours, viz., at the rate of eight or nine miles per hour on the ascent, and at the rate of from fifteen to twenty miles on the descent, as it may be considered unadvisable to allow heavy trains to descend with greater velocity.

The coal lying chiefly near the summit, or having only a few miles of ascent from the collieries, may be conveyed with very considerable economy by a systematic and well-organized arrangement. Generally, looking to the Stockton and Darlington Railway, and to the Leicester and Swannington Railway as examples of coal lines having gradients somewhat similar to those on this railway, I think that the coal traffic will be very great.

With regard to the cost of carriage of merchandize, it appears to me, as this Company will not be liable to the heavy expense of collecting and distributing the same from and at each terminus, that the outgoings on this head will be confined to those of the actual cost of transport between the two towns, and a very advantageous return to the Company will accrue, by carrying at rates lower than the present charges; and with an expedition, regularity, and certainty, which will be of the highest importance to the public.

The probable net revenue to arise from the gross receipts from the carriage of passengers, cattle, pigs, merchandize, grain, stone, minerals, &c., will, in my judgment, be very large; and from the total absence of all possibility of rivalry, either from road, canal, or railway, and from the very great improvement and economy

over the present mode of conveyance, not only between the extreme points, but through the whole district, I repeat my conviction that this Company will enjoy the exclusive trade, both present and prospective.

I have not considered the estimate in the detail, which I shall be enabled to do, now that the permanent sections and gradients are determined on; but I think that to carry the objects of this Company fully into effect, including the branch, the sum of one million will be required, but that will be an ample covering sum.

I have not thought it necessary to enlarge on many topics which I have touched upon in my original and in my subsequent reports; and the general advantages of a railway communication between towns and districts, so important as those of and around Sheffield and Manchester, are so manifest, that it is superfluous to accumulate arguments in their support; referring, then, to my preceding reports for the further illustration of my opinions in this matter, I have the honour to subscribe myself, Gentlemen,

Yours, &c.,

CHARLES VIGNOLES,

Civil Engineer, 4, Trafalgar-square, London.

*Liverpool, 25th Nov., 1836.*

MR. LOCKE'S REPORT.

*To the Committee of the Sheffield, Ashton-under-Lyne, and Manchester Railway.*

GENTLEMEN,—The plans of your proposed railway submitted to you by Mr. Vignoles and myself, at Penistone, in October last, have been, by us jointly, revised, and the differences of opinion which then existed between us have been reconciled. I have now the satisfaction to state, that we have agreed upon a line and a system of gradients, which, I trust, will be found to answer the object contemplated by you.

I have no doubt, but that the line of country selected is the best adapted for a railway between Sheffield and Manchester; and, whilst it gives facilities for connecting the important districts of Ashton, Stayley-bridge, Hyde, Mottram, and Glossop, is equally favourable for a junction with other railways in contemplation at each extremity of the line.

The principle by which I have been governed in selecting this line, is to preserve a uniform rise from each extremity to the summit of the country which is nearly midway between the two towns; and, considering the natural difficulties of the route, I have succeeded beyond my most sanguine expectations. There has already been before the public a project of a railway between Manchester and Sheffield, in which several tunnels and steep inclined planes were considered requisite, and judging from this project, and from a local knowledge of the district, I was at first

disposed to doubt, whether a line adapted for locomotive engines throughout could be obtained; but in carefully and seriously considering the question, I soon discovered, that a line embracing the very important districts enumerated, and on which locomotive engines would travel, might easily be made. This line will commence in Manchester, at Store-street, at an elevation of 168 feet above the sea, and pursue the same course as the Cheshire Junction Railway is proposed to take, until it passes the suburbs of the town. The advantages of forming this connexion have been adverted to in a former report, and I do not consider it necessary to repeat them.

After leaving the course of the Cheshire Junction near Chancery-lane, the line will proceed by the Old Pottery Works on the Gorton road to the Stockport canal, which the railway is intended to pass under, and then through some deep cutting to the Old Ashton turnpike road near the Fox Inn, and to the Guide Bridge. From this point the branch to Ashton and Stayley-bridge will commence, for the details of which I must refer you to Mr. Vignoles, who has attended to them more particularly than I have had the opportunity of doing.

From Guide-bridge the line will cross the valley of the Tame at an elevation of about 40 feet, thence over the Peak Forest Canal, and under the Dukinfield road. It will then curve to the southward, passing between Mr. Ashton's house and Newton Moor, and by the Duke of Sussex public-house at Newton Green, over the Hyde and Mottram road, up the valley near Godley Hill, to the Stockport old road, which it will pass under, either in a deep excavation or by a short tunnel. The line will then cross the wooded ravines in Hattersley, by Mr. Sidebottom's house and cottages over the Turnpike road there, and thence to Best Hill Mill, where it will cross the river Etherow at a very narrow pass, but at a considerable elevation. Proceeding forward by Upper Gamesley, the line will cross Dinting vale by a viaduct at a considerable elevation, leaving Glossop about three-quarters of a mile to the south, passing between the villages of Hadfield and Padfield, through Deep Clough Farm, and Torr Side, to near Woodhead; and after pursuing the valley of the Etherow for some distance above Woodhead, will enter into the high ridge of land which separates the Counties of Derby, Chester, and York. The tunnel, in order to make the inclination through it not greater than 1 in 264, has been increased in length, and will now be three miles; the eastern extremity being near to Dunford-bridge, at the head of the river Dun. This point is the summit level of the railway, and is 775 feet above the commencement at Manchester, 759 feet above the terminus at Sheffield, and 943 feet above the level of the sea. From the summit the line will descend uniformly to Sheffield, passing down the south side of the river, leaving Thurlston on the south, to the town of Penistone, below which it will cross the river Dun into the grounds of Outhwaite Hall, and thence

curving round the extreme end of the river at Wortley Forge, will enter Wharnccliffe Wood. The line will skirt the side of the hill which this Wood covers to near Oughtibridge Hall through Beely Wood, crossing the Wortley road above the Toll Bar at Wadsley Bridge, and proceeding by Wardsend through Scaith Wood and the Old Park Wood, across Harvest lane, passing under, by a short archway, the Barnsley road and the several streets at Bridgehouses to the Nursery Grounds, in Sheffield. The continuation of the line will be by means of a viaduct across the Wicker and the river Dun, into the Cattle Market, where the station is intended to be made. From this place also, a line is in contemplation to join the North Midland and Midland Counties railways, so as to form a direct communication between these lines and the one first described.

The gradients of the line, beginning at Manchester, are as follows :—

(These are precisely the same as in Mr. Vignoles' report, which see above.)

It will appear, therefore, that the steepest rise on the line, is one in 120; and experience has already shewn that on places more abrupt than this, the locomotive engine can be advantageously employed. There are also sufficient data before us to enable us to say precisely what load a certain sized engine will drag at a given speed on such a plane; but, without troubling you with the details, I will simply state, that with ordinary coach trains, an engine will traverse the distance between Manchester and Sheffield in less than three hours; and, although this may be considered a minimum speed on a railway; still, it must be borne in mind, that when contrasted with the present tedious mode of conveyance, it presents an improvement as decided and as important as any railway has yet established in any district of the kingdom. I need not repeat the admitted truth, that increased facilities of communication increase the number of travellers; and if this be true in general cases, how much more forcible does it become in the case before us; for, in spite of the worst and most hilly road in this country, the public conveyances are numerous, and are still increasing. I do not, however, wish to insist on the necessity of a railway between Sheffield and Manchester, or upon the fact that there is no direct canal communication between these important towns; for these, I presume, are already well known to you: but looking upon your project as one of great mercantile importance, destined to form the direct thoroughfare between the east and west seas, I have, in selecting the line, considered myself justified in incurring some expenses which might otherwise have been avoided. It is well known that the line of country presents some difficulties. The great ridge must be encountered; to maintain a uniform rise, some heavy works must necessarily be required; but the line has one great advantage—it is very *direct*; and although I would most willingly have lengthened it in order to obtain better gradients, yet in the

economy of construction, as well as of working the line, the directness will form a good set-off against the steep gradients, and will make the line as a whole, not so unfavourable as might be supposed. By way of illustration, let us compare this Line with that about to be made to Leeds. Sheffield and Leeds are nearly equidistant from Manchester; but whilst our Line is 40 miles long, that to Leeds is 60 miles; it is clear, therefore, that although we have steeper rises, and may require more powerful engines, yet that we have a less distance of road to make, to keep in repair, and to work; and these are, in the economy of railways, very important considerations.

The tunnel is an important feature in this undertaking, and is longer than any yet made on any railway for the conveyance of passengers. It is true that some prejudice has existed in the public mind against tunnels, but beyond the inconvenience arising from the steam from the engine, I see no reason for alarm. Lamps may be attached, as at Liverpool, to the carriages during their passage through, which would not occupy more than ten minutes; and by the introduction of a good system of ventilation, all real ground of objection, it is hoped, would be removed.

On the subject of the estimate, not having seen the plans or sections since the altered levels were taken, I have nothing to state beyond what my former report contained. I should not think the amount would be increased; but of this I can form no accurate idea.

I have not thought it necessary to enter minutely into the various local advantages which this line will give, nor have I ventured an opinion on the probable increase of trade which those localities may bring upon the line; but I cannot forbear to mention that it will pass through a flourishing manufacturing district on one side, and a rich mineral country on the other; the great, I may say the greatest unworked coal-field in England is contiguous to the line; and since this field must have an outlet to the eastern sea by the Humber, it amounts almost to a certainty that a communication between this Line and the Humber will at no distant period be made. This, in addition to giving to Manchester the important advantage of a railway communication with the grain district of Lincolnshire, will afford the readiest mode for carrying its yarns and manufactures for exportation to the eastern coast. There is scarcely any district in England in which some better mode of conveyance is more required than between Manchester and Sheffield; and although I do not hold out the hope on account of the gradients, that the velocity of transit will be equal to that on other railways constructed more nearly on a level; yet since the line is the best that the country will admit of, there is little chance of competition by any rival company.

I am, &c.,

*Liverpool, Nov. 24, 1836.*

JOSEPH LOCKE.

*On Axle-Tree Friction. By MECHANICUS.*

TO THE EDITOR OF THE RAILWAY MAGAZINE.

*Wolverhampton, Nov. 19, 1836.*

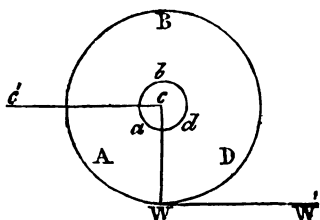
SIR,—I have read and attentively considered your article (in this month's number), on the Axle-tree Friction of Wheel Carriages, in which you invite the attention of the scientific world to the subject. Though I do not profess to belong to that body, I flatter myself that I can throw some light on this subject, and though I differ from you in opinion, I trust to your candour for the favourable reception of a few remarks which I have to make upon it.

Admitting the principle to be true, that "Friction between hard surfaces is proportional to the weight, but independent of the velocity or the quantity of rubbing surfaces;" it appears to me, that it must follow as a consequence from it, that the larger the diameter of the wheel is relatively to that of the axle, the less will be the *effect* of axle-tree friction in retarding the motion of the train.\* As far as I can understand the tenor of your article, you seem to be of a different opinion. You admit that, in the case of a wheel revolving on a fixed axle (the friction on the axle being constant), the weight acting at the circumference of the wheel in its plane, and perpendicularly to the radius, which will just balance the friction, is less as the diameter of the wheel, relatively to that of the axle is greater; for this is expressed by your equation  $F = W \frac{R}{r}$  which may be trans-

posed into the form  $W = F \frac{r}{R}$ ; but you seem to suppose that the force requisite to balance the axle-friction of the carriage is a different quantity from the  $W$  in the above equation. I shall therefore endeavour to show that it is the same.

\* Clearly, if neither the velocity nor extent of rubbing surfaces has any influence, the friction must be the same if the insistent weight be the same. Mechanicus is here evidently confounding leverage and friction together.—ED.

Let  $ABD$  be the circumference of a wheel revolving on  $\epsilon'$  an axle  $abd$  with a certain amount of friction.



There are two forces requisite to balance this friction; one acting along the line  $WW'$ , which coincides with the weight  $W$  in your equation, and the other acting in the contrary direction along the line  $CC'$ , which coincides with the force of traction in carriages. On the well-known mechanical principle, that action and reaction are equal,\* it is clear, that the force  $CC'$  is equal to the force  $WW'$ : and it is so whether the axle is fixed, and the wheel is made to revolve by means of a force moving in the direction of  $WW'$  or the plane  $WW'$  is fixed, as in the case of a railway, and the wheel is made to revolve by a force moving in the direction of  $CC'$ .

What I have thus endeavoured to prove theoretically, has been proved experimentally and practically in Mr. Stephenson's plan of railway carriages, in which the axle is made to project through the wheel, and the journal is turned on the outside: by which means it can be reduced with safety to a much smaller diameter than when it was between the wheels. [We should like to see the particulars of these experiments.—Ed.]

It is true that, as Wood says, this plan was not found to produce that effect in reducing the friction which was anticipated; probably owing to a circumstance which you mention, viz., That the solid bearings are more easily kept asunder by the lubricating medium. Still the advantage of it was sufficiently decisive to bring it into general use. But if the width between the rails be increased, so as to allow the body of the carriages to be lowered between the wheels,

\* Mechanicus here evidently is mistaken, and misunderstands the principle in question. Action and reaction must not only be equal but opposite forces, and should be applied to the same point. In the case in question they have neither of these properties. The force from the centre of the axle being not horizontal, but, as I have stated in No. IX., oblique upwards. If there was an inflexible line drawn from the centre of the axle, a line from the bottom of the axle to the extremity of this inflexible line would represent the direction of the tractive force.—Ed.



I do not see how this plan can, conveniently, be adopted. If, then, the journals of the axles be placed between the wheels, it appears to me that they will require to be increased in diameter, in a much greater ratio than the wheels can be. Probably the best thing that can be done in that case will be, as you suggest, to have the axle fixed, and to allow the wheels to turn upon it. I am, Sir, yours, &c.

MECHANICUS.

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*Birmingham Railway.*

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[Concluded from p. 449.]

The line continues by Eddesborough to Cheddington, being  $5\frac{1}{2}$  miles, descending at the rate of 14 feet to the mile, the cuttings and embankments in this division being entirely along the points of the adjoining ridge of hills are not serious, although apparently so upon the section, and being chiefly composed of chalk would stand at very small slopes, and by increasing the inclination here to 16 feet to the mile, about ten feet of cutting might be saved at the summit, and about a quarter of a mile in the distance. At Cheddington, the line crosses the Grand Junction Canal at an elevation of 18 feet, and continues descending 12 feet to the mile for  $8\frac{1}{4}$  miles to Weedon, and passes to the south of Wingrave and Bunton, about three miles to the north of the town of Aylesbury, to which a descending branch can readily be made. In this division no particular obstacle intervenes, except a small valley near Mentmoor, which must be passed by an embankment of 12 feet average for three quarters of a mile. From Weedon to Aylesbury there is a descent of about 30 feet, which might be readily approached with a branch from the Main line, and as this is a place of considerable importance, this might be well worthy of consideration. From Weedon to a place called Whitefield Farm, the line continues level for 3 miles without any material obstacle. The Thames, which is much subject to floods, must be crossed by a considerable bridge and a small piece of cutting and embankment.

From thence to Quanton Mill, a distance of three miles further, the line continues rising gently at the rate of 10 feet to the mile, with little more surface forming, and without interfering with any valuable property. By re-

ferring to the accompanying plan and sections, it will be seen that this line by the Dagnall summit is rather circuitous, on account of being compelled to keep so far to the northward. I consequently directed Mr. John Grantham to try the line by the Bickampstead and Tering Valley, which is already occupied by the Grand Junction Canal; from thence by Drayton, Bearton, Aylesbury, to Quainton, where it joins the former line: this certainly saves about 2 miles in the distance, but would be attended with a heavy piece of cutting of 30 feet for near two miles, and would partially interfere with the Reservoir and works of the Grand Junction Canal, which no doubt would render it objectionable to them; from thence however to Aylesbury, and even Quainton, no difficulty occurs. The distance from London to Quainton by the turnpike road is 47 miles, and by the railway section, as laid down, 52 miles, being an increase of 5 miles by the latter; but when the moderate inclinations which have been adopted are considered, and that no private parks, pleasure-grounds, or other valuable property have been interfered with, I trust, that so far the line upon the whole may be considered favourable, and is still capable of further improvement, by adopting the alterations abovementioned. Several other minor trials were made in the vicinity of the above, but as they proved abortive, it is not worth while to enumerate them. I also directed a line to be tried from Chesham, immediately above Uxbridge, to continue up the Amersham valley to Wendover and Aylesbury: this summit, however, proved to be 90 feet above that of Teing, and would have required an inclination of at least 30 feet to the mile, and an inclined plane and heavy cutting to Aylesbury: the distance, moreover, would be increased. I consequently abandoned this attempt as fruitless.

From Quainton Common the line continues by Doddershall to near Knoll Hill, a distance of 3 miles, falling 30 feet, or 10 feet to the mile. In this division there are several sharp pieces of equal cutting and embanking, averaging 12 feet for one mile and a half; from thence to the Chamdon and Twyford-road the line continues 3 miles further, rising 18 feet, of which the first mile rises 10 feet, and the other two 4 feet each; and these levels or inclinations are obtained without any difficulty—indeed little more than surface-forming is required. From Twyford-road to the Goddington-road, a distance of two miles and a-half, the line rises 20 feet, and will require an equal series of cuttings

and embankments for about 6 feet upon the average; from thence by a place called Fringford Mill over the high grounds of Shelnwell to Mixborough, a distance of 5 miles, the line rises 70 feet, or 14 feet to the mile division, the chief obstacles are a small valley near Goddington, which will require an embankment of 8 feet for a quarter of a mile, a piece of cutting through the side of Saul's Mills, averaging 17 feet high for a quarter of a mile, an embankment 3 furlongs 27 feet high; and the valley over off the Goddington river, one of the principal feeders of the Ouze in this embankment, a bridge about 30 feet wide will be requisite, and a considerable piece of cutting, near two miles through the high grounds of Shelswell, averaging 16 feet high: an inclination, however, of 20 feet to the mile will reduce this latter piece of cutting to little more than surface-forming. From Mexborough to the village of Evenly, a distance of 2 miles, the line rises 11 feet, with a trifling piece of cutting and embanking of about 15 feet for seven chains long. From thence to Heyne through the village of Hinton the line continues level for 3 miles, leaving Brackley about a quarter of a mile to the right. In this division several small valleys or dingles, followed by an equal quantity of cuttings must be crossed, which will be seen by referring to the section. None of these, however, present any material obstacle. From thence to Gretworth Hill, 1 mile and 5 furlongs, the line rises 12 feet to the mile; thence to near Marston St. Lawrence, three quarters of a mile further, falling 9 feet 9 inches. In this division there is no particular obstacle, but a heavy piece of cutting at Gretworth, averaging 25 feet for a quarter of a mile, which cannot well be avoided in this direction, as it is the lowest part of the ridge of hills which divide the summit of the Ouze from the Charwell: from thence to the ridge north of Middleton Chenny, the line continues rising 33 feet for 2 miles, and 2 furlongs, requiring a piece of cutting averaging 12 feet for half a mile. Here the country becomes difficult and rugged; and in order to cross the ridge, and to descend into the vale of the Charwell, a heavy piece of cutting averaging 35 feet for three furlongs must be encountered. The line continues through this by the villages of Chalcombe and Wilscoth, being a distance of 5 miles 1 furlong, and falling 74 feet, or nearly 15 feet to the mile. On account of the intricate nature of the country, surrounded on all sides by high hills, and intersected by deep valleys, the line is necessarily rather circuitous, and attended by

alternate cuttings and embankments, although these being mostly along the points of hills, will not be so serious in the execution as represented in the section. From the river Charwell to a small valley and water-course the line falls 9 feet in two miles. In this division the only obstacle is the valley of the Charwell, which must be crossed by an embankment and bridge, for which an excellent quarry is expected to be found in the heavy piece of cutting, near Middleton Cheney; the remainder will require little more than surface-trimming and forming: from thence to the entrance of the Oxford Tunnel, the line rises 33 feet in 2 miles and three quarters, through a very favourable country. From the Oxford Tunnel the line passes by Fenby, Cowpton, to Knightscoat, a distance of 4 miles and three quarters, falling 66 feet, or 14 feet to the mile. The principal difficulties in this division are the cutting at the Oxford Tunnel  $\frac{3}{4}$  of a mile long, averaging about 16 feet, and a small piece of cutting and embanking, averaging 12 feet high for half a mile: from thence to the lane leading to Southam, a distance of two miles and a quarter, the line continues by Bishop's Itchington, descending at the gentle inclination of 7 feet, which is obtained by alternate cuttings and embankings, averaging about 8 feet for the whole distance. Between Southam and Quainton various other trials have been made, to endeavour both to shorten the distance and relieve the various cuttings, and embankments, and inclinations above described; but under all the circumstances of the case, the line abovementioned appears most eligible. One line was tried by Grindon Underwood Marsh, Gibbon, and Bicester, to Lamestone; but here the country rises so rapidly, and subsequently descends so quickly into the vale of the Oxford Canal, that it was deemed inexpedient to pursue it further; moreover, to have obtained the desired inclinations, it would have continued too far out of the general direction without a very considerable sacrifice. Another line was tried in the direction of Chetwood, Barton, and Tingewick, to get into the vale of the Ouze: this also was abandoned on account of the rapid ascent of the country. A third line was tried by Farnham Fries, but was abandoned from the same causes as the second. A fourth line was attempted direct from the summit at Dagnall, along the high lands by Winslow and Buckingham, in order, if possible, to make the general line more direct, and to take these two places in the general communication, which at present is much wanted, but the great inequalities of the

country, surrounded by high hills, and intersected by deep valleys on all sides, rendered impracticable to pursue it, at any reasonable expense; it was also abandoned, although if it had succeeded, it would, no doubt, have shortened the distance most materially.

From Southam Lane the line continues by the village of Bascock to the Warwick and Napton Canal, a distance of four miles and a furlong, descending 57 ft., or 14 feet to the mile; the principal difficulties in this division are, the cutting near Green Hill Farm, being 18 ft. high and  $\frac{1}{3}$  of a mile long, and the embankment over the Warwick and Napton canal, which is about half a mile long, averaging 17 ft. high; the remaining cuttings and embankments are not serious. The above, however, may, I am inclined to think, be materially relieved upon further examination. From thence to the valley of the river Leame, being a distance of three miles and a half, the line turns to the left and continues by Snowford Farm, descending 42 feet at the rate of 12 feet to the mile without any material difficulty, or rather the country generally is very favourable, although the course is rather circuitous; I am in hopes, however, that this may be shortened about half a mile upon further investigation. From the river Leame to the hill near Bubberhall the line rises 33 ft. in 2 miles 5 furlongs, at the rate of 12 ft. to the mile; from thence to the river Avon, a distance of  $1\frac{1}{4}$  mile, falling 18 ft. or 14 ft. to the mile and then rising 1 mile to Bagginton Hill, 10 ft. in the above-mentioned three divisions, the intervening country is difficult and intricate, the chief obstacles are the vales of the Leame and Avon, the former must be crossed by an embankment 3 furlongs long and 14 ft. high, and the latter  $\frac{3}{4}$  of a mile long and 20 ft. high upon the average; the summit ridge of these two valleys at Bubberhall must be passed by a piece of heavy cutting averaging 24 ft. high for half a mile; as the interior, however, most probably contains good building stone the expense will be materially relieved. From hence to the valley of the river Sough, a distance of one mile, the line falls 10 feet, which is obtained by a piece of cutting 18 feet high and a quarter of a mile long, and an embankment 24 feet high and a quarter of a mile long. From the valley of the Sough the line continues by Cauley and Huenat to Redfen, a distance of 8 miles and 2 furlongs, rising 116 feet at the rate of 14 feet to the mile; in this division the surface of the country is generally rugged and uneven, although, with the exception of the piece of cutting at Redfen Hill, which is 36 feet high upon the average for half a

mile, there are no material difficulties, considering the nature of the country, beyond moderate cuttings and embankments. The vale of the Coventry river is passed by an embankment averaging a quarter of a mile long and 18 feet high. From here to Coventry, a distance of 2 miles, a fine line for a Branch Railway presents itself, and considering the importance of the place, the circuitous course is in a great measure compensated. From Redfen hill to the stream near Temple Balsall running down to Stone Bridge, a distance of 2 miles and one furlong, the line falls 21 ft. 6 in. or 10 feet to the mile, without any obstacle worthy of remark, as the whole may be accomplished with a little more than surface. Going from the above-mentioned river the line continues by Barston Kittle Bane Heath, crossing the Birmingham and Warwick Canal to near Kingsford Hill, a distance of 6 miles, rising 72 feet, or 12 feet to the mile, the direction of this division is rather circuitous, the other obstacles, however, are not serious. The Temple Balsall valley is crossed by an embankment a quarter of a mile long, averaging 15 feet high, a piece of cutting passing through the ridge near Barston, being 1 furlong long 25 feet high; and the Birmingham and Warwick Canal must be passed by a small piece of cutting  $\frac{1}{4}$  of a mile long and 9 feet high. From Kingsford Hill to the valley of the canal reservoir, a distance of 6 furlongs, the line falls 9 feet; from thence to near Acock's Green, a distance of 1 mile and a half, the line rises 15 feet or 10 feet to the mile; in these two divisions the surface is generally rugged and uneven; the principal obstacles must be overcome by an embankment 3 furlongs long and 18 feet high on the average, and by a piece of cutting 3 furlongs long and 18 feet high; the remainder of these divisions the cuttings and embankments, are about equal and not generally severe. From near Acock's Hill or Green to the Turnpike road near Spackbrook House, a distance of 2 miles, the line falls 24 feet or 12 feet to the mile, crossing the valley of the river Cole by an embankment 25 chains long, averaging 24 feet high, and a piece of cutting 30 chains long, averaging 9 feet high, and an embankment half a mile long and 8 feet high, which will be supplied from the cutting by Acock's Hill. From thence to the corner of Warren Lane, a distance of 1 and a half mile, the line continues nearly level, which is obtained by cutting through the high ground at the Alcester-road, averaging 25 feet high for half a mile long, and crossing the valley of the river Rea near the Wire Mills, by an embankment  $\frac{1}{2}$  a mile long, averaging 25

feet high. At Warren Lane, near the Birmingham and Worcester turnpike road, the line rises by an inclined plane 90 feet in a distance of 900 feet, or about 1 in 10, and a level of  $\frac{1}{2}$  a mile crossing the Worcester Canal to the Ilchington road where it unites with the proposed Birmingham and Liverpool Railway, being a total distance of 121 miles from London. From the embankment over the Rea one or two short branches may be made to communicate with the different parts of the town of Birmingham. Besides the general line above described, various other lines have been explored and tried between Brackley and Birmingham, one by Farthingboe, Washworth, Banbury, the Warrington Valley, Gaydon Hill and Ilchington, but the great inequalities of the ground and the numerous intervening valleys rendered this impracticable. Another line was tried from Gaydon Hill by Leamington, Warwick, and Kenilworth, which failed on account of the inequalities of the country and the numerous parks and other valuable and private property which it would have necessarily interfered with, although if it could have been accomplished a considerable portion of the distance would have been saved. Another was tried to avoid the Oxford Tunnel, which was equally unsuccessful; a fourth was tried from the Tunnel of the Oxford Canal to the northward by Rodburn and Southam Holt, in order to descend gently from the range of hills; this, however, was abandoned because it carried the line too far to the northward, and rendered it too circuitous. Four different trials were made to cross the Avon and Sough valleys; these also did not turn out so well as could be expected, another attempt was made to reach Birmingham by a more direct course over the range of high country extending from Minden to the southward; this also did not turn out more favourable. Another attempt was made to enter Birmingham from the north by Elmden, Shelden, and Yardley, but the high ground of the latter place forced the line so far to the northward that it was deemed unnecessary to pursue it further, the more so as it was considered advisable to unite with the projected line from Birmingham to Liverpool. Having now described the various trials that have been made in the prosecution of this important undertaking, I beg leave to add a few remarks. The principal objects in determining the most proper line are, to make the course of the Railway as direct as possible between London and Birmingham; to avoid, as much as practicable, all parks, pleasure-grounds, and other valuable public and private property; and to avoid interference with

existing canals and to embrace as many populous and important towns along the line as can be done consistently with a reasonable expenditure.

With regard to the first. The country between London and Birmingham may be chiefly divided into four districts, comprehending the vales of the river Thames, Aylesbury, the rivers Charwell and Avon, all of which are surrounded by extensive ridges of high hills, which are again intersected by numerous minor valleys, through which the tributary streams descend towards the principal rivers above-mentioned. To effect, therefore a direct communication between London and Birmingham, the whole of these must be passed by numerous inclined planes, extensive cuttings, and embankments, without regard to the situation of private property or otherwise; so that it will be extremely difficult to keep the estimate within reasonable bounds, and the only advantage in doing this, viz., shortening the line, would be more than counterbalanced by the above inconveniences. Viewing, therefore, the whole of these important objects in their true bearings, the general line above described has been adopted; the principal objection may be termed its length, being 121 miles, being 12 miles more than the mail-coach road from London; but when it is considered that this has been effected without a single inclined plane, with moderate inclinations of 14 feet to the mile, except in one instance of 15 feet to the mile—without interfering with any parks, pleasure-grounds, or valuable public and private property, with the single exception of Goddesdon Park, and that in a most trifling degree, a circumstance which must tend in a most material degree to conciliate the good wishes of the landed proprietors through which the line passes—without interfering with any of the works of the existing canal, and for the most part passing through a line of country where no good communication, either of road, or canal, or railway, exists, and comprehending the populous manufacturing town of Coventry, which alone is an object of the greatest importance—and, lastly, without any extraordinary difficulty in the execution so as to occasion an unreasonable expenditure.

I hope it will be allowed that the line adopted possesses advantages which go far to counterbalance the increase of distance, particularly when this distance is still less by 40 miles than the shortest canal navigation from London: moreover, I have reason to believe, that by increasing the inclines in some cases to 20 ft. to the mile, and by examining the whole line more carefully previous to making the final



section, that it may be most materially improved, and that the distance between London and Birmingham may be reduced to about 116 miles, which would then be 45 miles nearer than by the canals. I cannot close this report without acknowledging the unwearied zeal, attention, and ability with which Messrs. John and Edward Grantham have prosecuted the various levels and surveys. I have directed them to present the sections and plans, and they will be able to give any further explanation concerning the details which you may require: and I have only to request that I may be informed of your determination as early as possible, because, as the season for active operations in the field is now rapidly advancing, if this scheme is to be prosecuted, no time should be lost in proceeding with the final section and survey, and in ascertaining the opinions of the landed proprietors and occupiers along the line, in order that the whole scheme may be properly adjusted so as to be ready for the approaching session of Parliament, by which means a considerable saving, both in time and expense will be made.

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### *Harwich Railway.*

[In our last Number we presented our readers with a coloured map and a very brief sketch of the above line. Since then we have applied to a gentleman, who is well acquainted with all its details, and on whose information we could place reliance for such particulars as would enable us to make a fair report of the line; in lieu of which he has sent us the following description, which we submit to our readers in preference to any thing we could write.—ED.]

The port of Harwich is well known to mariners to be not merely the best, but to be the *only* harbour and port of refuge upon the eastern coast of England. It is, moreover, easily accessible in all weathers, and in every state of the tide, and has sufficient depth of water for, and is capable of containing more than all the shipping that can be found at any one time in the German Ocean, upon which it opens.

The convenience of this port to the ports of Holland, and the facilities the use of it would give to the commercial intercourse of this country with Holland and Belgium particularly, and with the north-eastern parts of Europe generally, as well as its importance to our domestic communications, if there were a rapid and economical means of transit between London and Harwich, need not be pointed out here, as this has been done truly and with very good

effect in the statement put forth by the Company, and which will be found on the cover of the Number of our Magazine in which the map of the line is inserted.

In laying out this new line with reference to Harwich, it was obviously the duty of the engineer to give it that direction which would tend most to shorten the distance from Harwich to London—the face of the country and the natural and artificial circumstances being also considered with regard to economy. It will be seen, by reference to the map, that the Eastern Counties Railway, into which the Harwich has to run, passes by Colchester in a line pointing to Harwich, and then turning northward to Ipswich, leaves the former town and port between eleven and twelve miles distant at the nearest accessible point by land. A railway from Harwich, laid down with reference to the interest of the Eastern Counties Railway Company, would have taken, as nearly as circumstances would admit, this the shortest course to it; but it is equally clear that, laid down with reference to the interests of its own proprietors, which are to be served by securing the greatest degree of convenience to the traveller and merchant, the Harwich Railway should be directed to the Eastern Counties Railway, where this latter points to Harwich, and before it turns northwards to Ipswich, and consequently be a tangent to the curve which it forms in taking that course; for as any two sides of a triangle are together greater than the third side, so must the distance from Harwich to the Eastern Counties Railway, at any point north of the springing of the curve before-mentioned, together with that portion of the latter railway which may intervene between the two points, be greater than the distance from Harwich by a line drawn directly to the former. But independently of the greater distance, the passenger to or from Harwich and London must be taken between *forty and fifty feet higher up in the air* to descend again, *if made to traverse but three miles more* of the Eastern Counties Railway north-eastward from the now proposed point of junction of the Harwich line.

There can be no question, then, that the line laid down for the Harwich Railway is the proper one with reference to the two important subjects of inquiry—distance and altitude; we have now to inquire, what are its relative merits with regard to the natural and artificial circumstances which affect its economy.

Reference to the map again will show that Harwich is at the extremity of a promontory formed by the rivers Colne and Stour, and the streamlets running into one and the

other of these rivers from it, will be seen to point to the ridge or back-bone of the promontory. The point to be attained—the level of the Eastern Counties Railway at the nearest convenient point—is so considerably above the level of the town of Harwich, that the line from Harwich must rise gradually along its whole length, or there must be steep acclivities in some parts of it. From the extremity of the promontory, the main land rises gradually to the Eastern Counties Railway, so that a line laid along it and drawn nearly straight, as it is seen to be in the map, from the end of the curve which leads round the sickle-shaped tongue of land on which Harwich stands, to the springing of the curve before alluded to in the Eastern Counties Railway, is found to go in shallow cutting the greatest part of the whole distance with depressions near to either end sufficient to consume what is taken out of the cuttings in embankments, while the existing inequality of the surface is such as to allow of the turnpike and country roads being easily led over the railway. A line north of this and directed to the Eastern Counties Railway by a short curve, must traverse the valleys in which the streamlets run to the Stour, and have a higher summit to reach with diminished means of attaining it, because of the greater quantity of soil required for embanking along such a line, and but a short distance further northward than the present line would have required that the line should pass through a nobleman's park, an obstruction which is not encountered at all in the course selected.

The town of Harwich is situate on the point of a tongue of land which locks in with a headland on the opposite coast of Suffolk, and forms, with its assistance, the secure and beautiful harbour known as the Port of Harwich. From disuse, an extensive deposit of silt has taken place close in shore, but beyond the ooze there is depth of water sufficient for ships of almost any burthen, and the removal of a portion of it will enable vessels of all descriptions to lay alongside the quay at which the station of the railway will be formed, whilst the constant agitation of the water, occasioned by the action of the paddle-wheels of the steam-vessels, will prevent, in a great degree, if not entirely, the recurrence of this obstruction. No works or constructions of any importance will therefore be required to render the necessary communications between the harbour and the landing-place of the railway station quite independent of the use of boats, as steam-boats or other vessels may lay alongside of wharfs in the port of Harwich as quietly and safely as they do in the River Thames.

The railway will leave the station on an embankment of from eight to ten feet in height over the marshy meadows which occupy the inside of the tongue of land at the end of which the town stands, and continue upon it for the first mile level, but in a curve, of which the radius is sixty chains, or three quarters of a mile. The level, the curved line, and the embankment cease together at the end of the first mile, and from thence the line of the railway is straight for fifteen miles, or to the point where it comes in contact with the Eastern Counties Railway, near Colchester. The second mile out of Harwich is in cutting to an extent sufficient to form the embankment for the first mile, and the railway rises at the rate of 1 in 503 through this cutting, and for the third and fourth miles, which latter are upon an embankment from six or eight to twenty and twenty-five feet in height, over low land and the salt marsh through which the rivulet called the Ramsey River runs to the Stour. The railway rises through the fifth and sixth miles at the rate of 1 in 406, in short alternating cuttings and embankments, the former averaging about ten feet, and the latter about fifteen feet. The next three miles are, with a trifling exception, all in cutting, of an average depth of sixteen feet, and will supply the materials for the Ramsey embankment, the rise continuing through this distance at the rate of 1 in 391. The tenth, eleventh, and twelfth miles are mostly in shallow cutting, and the railway rises through them at the rate of 1 in 704. The thirteenth and fourteenth miles, and twenty chains of the fifteenth mile, continue to rise, but at the rate of 1 in 1320 only, in a cutting varying in depth from six to ten feet. At the end of this, the cutting and ascent cease at the edge of a valley, over which the railway is to be carried on a level embankment sixty-four chains long on the surface, and of an average height of twenty feet. In the sixteenth mile, and part of the seventeenth, the railway passes in cutting under the Manningtree and Ipswich roads, descending at the rate of 1 in 550, when it emerges upon a level embankment of from eighteen to twenty feet in height, a little more than a mile in length up to the station of the Eastern Counties Railway at Colchester. From this station the Harwich trains will run to and from London upon the Eastern Counties Railway.

There will be about one million yards of cutting upon the Harwich line, and the embankments will consume the whole of the soil that comes out of them.

The average lead will not be more than one mile, with

the exception of the soil necessary to form the Ramsey embankment, which will come mostly out of the seventh, eighth, and ninth miles, but the lead there will be all down the steepest parts of the line. Indeed, all the soil goes down hill, excepting the small portion in the shallow cutting along the middle of the line, which will be thrown up to form fencing mounds, and the stuff for the embankment in the fifteenth mile, which will go for the most part out of the cutting in the thirteenth and fourteenth miles, in which the railway rises only 1 in 1320.

The line passes through a fine agricultural district, but in such a manner as to subject the occupiers to little or no inconvenience; while the greatest part of the land being flat, though elevated, will be materially benefited by the drainage the cuttings will afford, and by the facilities the railway will give for bringing the chalk used in manuring it up from the barges which bring it to Harwich, as the farmers have now to haul it in their carts and waggons six, eight, and ten miles up hill, over cross country roads, from the Colne and Stour.

The comparatively small quantity of earth-work, and the shortness and facility of the leads,—the absence of ornamental enclosures, and of any necessity to interfere with or remove valuable buildings,—the ease with which all the roads are crossed, and the cheapness with which the stone and iron required for the construction of the railway may be brought coastwise to Harwich, and delivered along the line by the railway itself, are all concurrent in keeping the estimates much below the customary average for such works.

The estimates are stated as follow:—

#### *Outlay.*

Purchase of land and compensations, making and forming the road, drains, fences, &c., and constructing the permanent railway in double, or going and coming lines, $17\frac{1}{2}$ miles, 8,500 <i>l.</i>	£	s.	d.
per mile . . . . .	148,750	0	0
Station and works to perfect landing-place at Harwich . . . . .	30,000	0	0
Depôt by the station of the Eastern Counties Railway, at Colchester . . . . .	5,000	0	0
Engines, machinery, and carriages . . . . .	16,250	0	0
Preliminary expenses, management, and contingencies . . . . .	20,000	0	0
	<u>£220,000</u>	<u>0</u>	<u>0</u>

*Annual Income.*

Passengers by Foreign, Scotch, and North-Country steam- vessels, including also exist- ing traffic and passengers by sailing vessels . . . . .	208,468	Rate per Mile. at 2d. . . . .	£	s.	d.
			27,795	14	8
Goods—including bale-goods, and all descriptions of gene- ral merchandise . . . . .	115,093	Tons. ,, 2d. . . . .	15,345	14	8
Fish . . . . .	10,400	,, 2d. . . . .	1,386	13	4
Agricultural produce of all de- scriptions, including manure, &c., averaging 10 miles . . . . .	31,256	,, 2d. . . . .	2,604	13	4
Small packages and parcels not included in the above items; carriages, horses, &c. . . . .			3,786	17	5
Conveyance of the mails . . . . .			1,000	0	0
Income to be derived from the landing-place . . . . .			4,406	15	2
			<u>£56,326</u>	<u>8</u>	<u>7</u>

	£.	s.	d.
Gross amount of annual Income brought down . . . . .	56,326	8	7
Deduct annual expenses of work- ing and maintenance . . . . .	16,000	0	0

Leaving a clear annual profit of £40,326 8 7 or 18 per cent. on the whole capital of the Company.

We may remark, before concluding our account of this undertaking, that the cost of constructing from a mile to a mile and a half of what is proposed to the Harwich line, might be saved, by running its trains in upon that of the Eastern Counties where it comes in contact with it, instead of running nearly parallel to it for the distance referred to. This it is not thought advisable to do for several reasons, and principally because at the point in question the Eastern Counties Railway is upon an incline of 1 in 330, which is much steeper than any part of the Harwich line, whose incline in the parallel portion is at the rate of only 1 in 550, whilst the obtaining of this gradient makes it incumbent to embank the remaining short distance as the most economical mode of disposing of the earth taken out of the cutting in which that gradient occurs; and to run into the Eastern Counties Railway short of Colchester would also pledge the Harwich Railway Company to the same mode of

constructing and working their line which may be adopted by that Company, and this may be avoided by going independently up to their station at Colchester.

Moreover the intercommunication can be effected most to the advantage of both companies at a main station, which happens in this case to be attainable by the addition to the line of one of them, of a short extent only, whilst the tolls upon this additional extent are not an addition to the cost of transit of the traveller and merchant, but they will go into the treasury of the Harwich Railway Company instead of that of the Eastern Counties, and enable the former to maintain its establishment with a proportionately less deduction from the profits of the proprietors.

### *Cheltenham, Oxford, and Tring Railway.*

THE following statement has been handed to us respecting a line, under the above title, started against the Cheltenham and Great Western Union Railway, which obtained its bill last session. As this matter is making a considerable noise in the western parts of the kingdom, and is likely to create great Parliamentary discussion, we think it right to lay it before our readers.—ED.

The Parliamentary plans and sections deposited with the clerks of the peace, establish numerous contradictions to the recent Report of Directors of this Company (signed "Pearson Thompson," Chairman), and at the same time furnish accurate means of comparing the engineering qualities of this projected line with the Railway from Cheltenham to Swindon, already sanctioned by Parliament, and the following facts elicited from those authentic sources, are promulgated for public information.

*By the Directors' Report, advertised in the Times newspaper, 7th December :—*

#### DISTANCES.

Gloucester to London,  $9\frac{3}{4}$  miles shorter by Tring than Swindon.

*By plans and sections deposited with the clerk of the peace, on or before 30th November :—*

#### ACTUAL MEASUREMENT.

	Miles	Ch.
Gloucester to London,	107	78
By Tring . . .	113	42
By Swindon . . .		
Difference	5	54

Cheltenham to London, 23½ miles shorter by Tring than Swindon.

Cheltenham to London,

By Tring . . .	99	61
By Swindon . . .	119	50

Difference	19	69
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#### TUNNELS.

No single tunnel will exceed 500 yards in length.

#### GRADIENTS.

For the traffic from Worcester to London, there will be a saving of 5 miles, and the gradients of this line (excepting the Dowdeswell plane) do not in any case exceed 16 feet per mile.

#### INCLINED PLANE.

(Excepting the plane at Dowdeswell.)

#### TUNNELS.

At Sandywell, near Andoversford, tunnel, 47 chains; or 1034 yards.

#### GRADIENTS.

The first gradient upon the Tring line, after quitting the Gloucester and Birmingham Railway, is 1 in 212; or 26 feet per mile, for 1½ mile.

#### INCLINED PLANES.

##### M. Ch.

One of 1 2 . . 1 in 44!!  
and

One of 1 3 . . 1 in 30!!!

*We are such old fashioned admirers of truth, that we cannot help expressing our indignation whenever we see or hear it deliberately violated. We should be glad to hear, therefore, what plain unsophisticated answer the authors of the preceding statements in the left hand column, can give to the figures in the right.—E.D.*

Although the Directors' report is prudently silent upon the point, the Tring prospectus states the distance to be 6 miles less from Oxford to London.

The actual distances by sections however prove,

Oxford by Tring to London . . .	60 miles	50 chains
Oxford by Didcot to London . . .	62	10

Difference only 1 mile 40 chains.

It may be alleged, perhaps, and truly, that the London and Birmingham station, at Euston Grove, is nearer to the City than the Great Western station at Paddington, whence these respective distances are calculated; but on the other hand, it is worthy of observation, that the latter depôt is nearer and more direct both to Piccadilly and Oxford-street; and it may be fairly assumed, that as far as the traffic from Oxford and Cheltenham is concerned, *not being commercial*, three-fourths, at least, in number of passengers will be destined for the west end of London. The fares to



the City, by public conveyance, are at present the same from both places.

The several inaccuracies thus enumerated are however trivial indeed, when contrasted with the total suppression of facts of material value in determining the comparative superiority of the two lines.

Admitting the distances to be more or less favourable to the Tring, the first inquiry is naturally directed to the general features of the country to be traversed. What are the respective summit heights to be attained? This must be acknowledged on all hands a principal ingredient in the comparison, inasmuch as Mr. George Stephenson, and other engineers of ability, have proved that 20 feet of vertical rise may be generally esteemed equal to one additional mile of distance.

The following statements are indisputable, being deduced from the Parliamentary plans and sections already referred to :

## LONDON AND OXFORD.

<i>By Tring.</i>				Ascent	<i>By Didcot.</i>				Ascent
From Euston Grove to					From Paddington to Ox-				
Tring.	.	.		ft. 348	ford depôt (no interven-				
From Oxford depôt to					ing summit).	.	.	.	127
Tring	.	.		202	From Oxford to Paddington.				Nil
	M.	Ch.		—	Tunnels (none)				
5 Tunnels	2	21		ft. 550					

In making the journey from London to Oxford and back again, the traffic must therefore overcome 423 feet of vertical rise by the Tring, more than by the Didcot line, making an average excess each way  $211\frac{1}{2}$  feet, which is equal, upon Mr. George Stephenson's evidence, to an extra distance of  $10\frac{1}{2}$  miles between Oxford and London.

## LONDON AND GLOUCESTER.

<i>Tring Line.</i>					<i>Swindon Line.</i>				
From Euston Grove to					From Paddington depôt to				
Tring	.	.		348	Swindon	.	.		252
From Oxford branch to					From Perton to Sapperton.				114
Andoversford	.	.		333	From Gloucester depôt to				
From Gloucester depôt to					Sapperton	.	.		342
Andoversford	.	.		477	From Purton to Swindon	.	.		25
From Oxford branch to									
Tring	.	.		192					
	M.	Ch.		—					
7 Tunnels	3	6		1,350	2 Tunnels	1	76		783

The excess both ways is 617 feet, or an average excess each way by the Tring line  $308\frac{1}{2}$  feet; equal, as above, to an increased distance of fifteen miles between Gloucester and London.

## LONDON AND CHELTENHAM.

Feet			Feet		
From Euston Grove to			From Paddington dépôt to		
Tring summit . . .	348		Swindon . . . . .	252	
From Oxford branch to			From Purton to Sapperton.	114	
Andoversford . . .	333		From Gloucester to Chel-		
From Cheltenham to ditto	339		tenham . . . . .	97	
From Oxford branch to			From Cheltenham to Sapper-		
Tring . . . . .	192		ton . . . . .	321	
	M.	Ch.	From Purton to Swindon .	25	
				M.	Ch.
7 Tunnels	3	6	2 Tunnels	1	76
		1,212			809

Aggregate excess 403 feet: average each way  $201\frac{1}{2}$  feet, equal to ten miles increased distance between Cheltenham and London.

The gradients between Oxford and London may be stated generally to consist of sixteen feet per mile upon the Tring, against four feet per mile upon the Didcot line.

The gradients between Gloucester and Cheltenham and London, may be stated the same as above (with two inclines of almost unprecedented steepness for passenger traffic, being 1 in 30 and 1 in 44) upon the Tring line, against the same scale of gradients on the Swindon line for forty-three miles (with one plane of 1 in 71), and the remainder (76 miles upon the Great Western Railway) not exceeding in any case six feet per mile. There is also an inclined plane of 1 in 82 on the London and Birmingham line near Euston Grove.

*We should much like to see the actual sections of these various lines. Judging from the above accounts, we can hardly think any one would be unwise enough to intend going into Parliament with a line having such gradients as the Tring must, against the Swindon line so obviously superior, and being besides already sanctioned by the Legislature.—ED.*

The report alleges that the Committee of the House of Lords deducted from the estimates of the Swindon line, half the Gloucester traffic, and the whole of the Cheltenham traffic, and that the Swindon Railway was declared, by a resolution of the House of Lords not to be a competing Railway with the Tring line.

It is denied that any deduction was made by the Lords from the Swindon traffic, and the minutes of evidence will disprove the assertion. The promoters of that Company did indeed show, as

they were advised to do, that their whole traffic from Cheltenham to the Metropolis did not exceed 36,800*l.* per annum, a sum obviously inadequate to maintain any separate line, unless combined with other intermediate traffic; such as exists between Gloucester and Cheltenham, and Stroud and Cirencester, with the trade between London and the latter commercial districts, in which the Tring line can never participate.

It was in reference to the admitted fact that no railway communication for the service of the manufacturing trade of Gloucestershire was offered by the Tring line, that the Lords would not recognise it as *competing in the main objects proposed by the Swindon Company*, but to urge that, as respects Cheltenham and Gloucester traffic to London, the Tring line is not a competing railway, is a manifest absurdity.

The merits of that question will be brought before both Houses of the Legislature, and they must judge, first, whether there is a public necessity or adequate traffic for a second line to London from Cheltenham; and secondly, whether the Tring line is the best that can be obtained.

*Can any one imagine that the Legislature having only last session granted one line, will for a moment, entertain the idea of another to a small place like Cheltenham, and even before the first has been made !!!—ED.*

Abundant evidence will be furnished to establish the converse of both these two propositions, if indeed any should be wanting, beyond the positive admission of the engineers employed in the last session, against the Swindon Railway.

Many influential land-owners on the Tring line, have announced their determined resistance to the measures, and will not fail to press these points to issue in opposition to any compulsory power for taking their property, merely to gratify the vindictive feelings of a few individuals, against the interests of other existing companies. The circumstances under which this scheme was promoted and is kept alive, shall be thoroughly investigated, and it will then be ascertained whether the identical parties who are now urging forward the Tring Railway are not, in fact, the most clamorous in vindicating, for their own benefit in the north, the very principle of security for incorporated companies from competition, which they so grossly violate in this case.

The proprietors may indeed passively permit the engineer and solicitors to divide the remaining spoil in Parliamentary warfare [*We hope, if the proprietors should be so liberally disposed, that they will bestrew their benefits over the Editor of the Railway Magazine, who, we beg to whisper to them, is a very good sort of man.—ED.*]; but if they rightly understand or pursue their own interests, the transfer of 4*l.* per share into their own pockets, would

be the unanimous demand of every subscriber, in preference to a blind perseverance in that, which must infallibly lead to the ultimate loss of all that has been paid.

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*On the Habitudes of Iron and Steel. Rejoinder of C.  
to Mr. Maugham.*

TO THE EDITOR OF THE RAILWAY MAGAZINE.

Sir,—Not being able to plead the same excuse as your correspondent Mr. Maugham—that nature has endowed me with an indolent disposition,—for delaying to answer his letter, I take the earliest opportunity of replying to his observations in your last number, as it would be very uncharitable in me not to endeavour to allay the fears he entertains, from what he is pleased to call my boldly-advanced theories, which he seems to apprehend will, if correct, annihilate the whole science of chemistry. As I frankly acknowledge my inability to build up a better, this would be a most unfortunate catastrophe if the scientific world did not possess a gentleman who is capable of tossing them up another in a trice—like a pancake on Shrove-Tuesday, hot and ready for use. The gentleman whom I allude to as being so *au fait* at constructing theories, is Mr. Maugham; but unfortunately, so eager has been his search for the mote in his brother's eye, that the possibility of a beam being in his own has never entered his imagination; for while he condemns the bold hypothesis of another, he, with a stroke of his pen, settles matters of science, which have engaged the attention of philosophers for ages. An instance of this I will allude to here. He objects to my expression, “that the element of heat is altered,” &c., an expression intended merely in a popular sense, though I readily admit it is not philosophical—of which more hereafter;—but he grounds his objection on this; not that it is unphilosophical, but that heat is nothing whatever but “intense chemical action.” Now, I will not assert that this is a bold hypothesis, for I suppose Mr. Maugham would not assert that for which he cannot give a good reason; but I do hope, now that our anticipations are raised of settling the long-disputed question as to what heat really is—whether it be “*quiddity or entity*,” as Hudibras would say,—we shall not be left without a full account of this great discovery.

But I must take the subjects of Mr. Maugham's letter *seriatim*. The difference between cast iron and steel he states to be, that cast iron contains oxygen and carbon, and steel carbon only, in combination with the iron. How then can this be reconciled with the fact mentioned in Mr. Maugham's first letter in your Magazine (page 184), where he describes having fused some cast iron and dropped it into water, *which he then found to be steel?* What became of the *oxygen* in this process? because Mr. Maugham considers it is "the elevated temperature of the puddling furnace" which causes "the oxygen in the cast iron to combine with the carbon, which the iron had acquired in the casting furnace," and makes them both pass off in the "state of carbonic acid gas." If, therefore, the oxygen was dissipated in his process, the carbon must have been so likewise; and yet he uses the words, "iron or steel," indifferently, as applied to the result of his experiment. Now carbon and oxygen combine at the very lowest temperature at which the former will ignite; and, therefore, it may very well be doubted, whether "the elevated temperature of the puddling furnace" causes the combination Mr. Maugham supposes; and whether it would not, on the contrary, decompose the carbonic acid gas: for there are few compound bodies, on which the effects of heat continue uniform through such an immense range as from the lowest temperature of ignited charcoal to upwards of 20,000 degrees of Fahrenheit's scale; which being the temperature of melted cast iron, must be less than the heat of the furnace. But is it not, on the contrary, extremely probable, that at this immense elevation of temperature, carbon may assume the gaseous form, though at a low temperature it cannot be obtained in that state: for it has been held by some philosophers, that every known substance, even the most infusible, might be made to assume the gaseous form, if we could command a sufficient degree of heat. But better than any hypothesis is the fact, that if cast steel be too hard, by melting it a second time it loses a portion of its carbon, and becomes softer, and this to any extent, according to the length of time it is kept in fusion, although no oxygen be present to convert the carbon into carbonic acid gas. So likewise in the process of making blister steel, if the iron imbibe too large a dose of carbon, it will immediately pass into the state of cast iron, and this when no oxygen could enter into combination with it.

We have, therefore, the most convincing proofs that cast iron and steel are convertible into each other without the presence of oxygen: that oxygen, if it does exist in cast iron, is not an indispensable element, and that carbon *can* be evolved from iron without the presence of oxygen, or being turned into carbonic acid gas.

Your correspondent also objects to the manner in which the explosions were stated to occur in casting iron, which I stated arose from the "formation of a quantity of inflammable gas within the mould—hydrogen, no doubt, mixed with a portion of oxygen." He admits this may occur, and then denies the hydrogen would inflame, "because it requires the presence of oxygen;" though immediately before he had admitted the existence of oxygen as well as hydrogen, both being obtained from the decomposition of the water contained in the sand. From this I am irresistibly led to think that—to use his own expression—"though he sees a mass of things, he sees but few of them distinctly."

The conclusion Mr. Maugham arrives at is, that the explosions are merely steam at a high pressure. But first, let me ask, did Mr. Maugham ever hear of *steam* at a temperature of 20,000° of Fahrenheit? for, as this is the heat of melted cast iron, the *steam* in the mould would, I apprehend, be the same. He, however, seems to entertain some doubts upon this subject himself, for he says, "If this is deemed unsatisfactory," &c.; and then goes on to ask, how it occurs that explosions take place during the casting of those metals which do not decompose water, and from what source are the inflammable gases then obtained?

First, as regards iron.—When the moulds are very thin there are innumerable small jets of pale blue flame, playing over the surface of the mould for some minutes after the iron is poured in. When the mould is thicker, and this inflammable matter cannot so easily escape, a slight explosion occurs, and flame generally comes out from some part of the mould. Now this I apprehend *is not steam*, because I never heard that steam would inflame. But when water is converted into steam, and this again into its elementary gases, we should have what I previously stated—hydrogen mixed with oxygen. And as Mr. Maugham has discovered that "heat is nothing but intense chemical action," we can, on his own theory, account why these gases are evolved; because, he will surely admit, that a "chemical action" will decompose water. That *heat* will do this, may be

proved from the experiment mentioned in his first letter to you. In commenting upon that experiment, I pointed out how the effect might be accounted for of the iron not decomposing the water; and the *heat* in that experiment would be insufficient, because, from the small quantity of iron, and large quantity of water, as soon as any heat was imparted to the water, it would, being unconfined, pass off, and its place be supplied by an upward current. But the explosions which occur in the ordinary way of casting iron are very different. There the water is *in* the mould, and not having any escape is decomposed by the intensity of the heat, even though a repulsion should exist between the iron and water. As these explosions occur long before the iron ceases to be luminous, or even before it loses its fluidity, it is certainly not the metal, but the intensity of the heat which causes the decomposition, if the experiments of Mr. Maugham, and those of Perkins and the Franklin Institution be correct, which show that the water is repulsed by iron at a red heat. Whether these gases will likewise be evolved from the casting of metals which do not possess the power of decomposing the water, will depend upon the temperature at which they melt. With lead, for example, the effect of its forcible expulsion from the mould is clearly owing to steam, because the temperature being only about 600° steam may be supposed to exist; but there is a vast difference between that and 20,000°, which is the heat of melted iron; and the simple fact, that *flame*, with or without explosion, according to the thickness of the mould, does attend the casting of iron in sand, is a proof that inflammable gases are given off, and not steam, as Mr. Maugham supposes.

Objection is also taken by your correspondent to the expression, that "the moulds of sand or loam would *dissolve*" when placed under water, as he proposed. I can see nothing objectionable in the expression, when taken in its obvious and popular sense, which, of course, means the moulds in such a situation would become shapeless and useless masses of sand. But the iron moulds Mr. Maugham proposes to use would not serve his stead for "casting busts and other ornamental articles," because none but the simplest forms of castings can be got out from an iron mould, in however many pieces (consistent with utility) it were made. If, like Frankenstein, Mr. Maugham could endue his bust with life after he had made it, he might,

perhaps, be startled with a similar question to that proposed to an honest countryman, who, finding a difficulty in heading up an empty cask, in consequence of the head slipping from its proper place, placed his son inside to hold it up, and in this manner had, with great satisfaction just driven in the last nail, when the boy called out from the inside, "Father, ha'e ye done? which way am I to get out?"

We now come to the grand difficulty which has alarmed Mr. Maugham for the stability of chemical science, in consequence of my stating "the element of heat is so materially altered when operating on large masses" of matter, to what it is when experiments on the small scale only are made. The expression may not be philosophical, but the context of the passage evidently shows the meaning to be, that when such large masses of matter are operated upon, the heat is so immensely increased, that the results are almost always different from the experiments of the laboratory. This difference does not arise, as Mr. Maugham supposes, from the greater purity of the materials used by the chemist, because, when he wishes to imitate the process of the manufacturer, in order to trace the cause of any result, he of course uses materials as nearly as possible the same: he may test those results, it is true, with more pure materials, but then he knows beforehand the results will be different. Mr. Maugham's plan would enable him to form about as accurate a judgment of the results to the manufacturer, as that of the Irishman, who, wishing to commit suicide, thought he would first try the experiment of shooting his image in the glass: the operation might *look* the same, but the results would not prove analogous.

I much regret that part of Mr. Maugham's letter is so brief which states his discovery, that "*heat is nothing more than the result of intense chemical action.*" I must candidly confess this is a thing which I cannot "see distinctly;" and, perhaps, it was this Mr. Maugham alluded to in using that expression. I certainly cannot "see distinctly" how heat, from friction or percussion of homogeneous metals, or by friction of two pieces of ice, can be the result of intense chemical action; or how, on this hypothesis it can happen, that the particles of many compound bodies may remain in close contact without uniting, *unless the temperature be raised*, and then the combination will proceed with rapidity; because in this case, "intense chemical action" would be *both* cause and effect—a thing



which I cannot "see distinctly." I hope Mr. Maugham will not fail to "*explain* distinctly" these things, because, no doubt, there are others as well as myself, "who cannot see them distinctly."

But there is still another topic at which your correspondent takes exception. In my last letter, I stated my reasons for thinking that iron and carbon do not combine in definite proportions; adding, with a modesty befitting the occasion, "I think," &c., which Mr. Maugham considers a very *per saltum* way of arriving at nothing. He first objects when a decided opinion is given that it is a bold hypothesis, and then he objects, when an opposite course is taken, that nothing is accomplished. "Why zounds," I might exclaim, in the language of a certain functionary, who, while administering the *coup de baton* to the back of a *mauvais sujet*, was continually interrupted with cries of "Strike higher!" "Strike lower!" "Zounds, Sir," said he, "there is no such thing as *pleasing* you strike how I will." Some persons might think, in that case, the objection lay in the *radicle* of the operation, and that the patient was resolved not to be *pleased*. Whether the same holds true in the present instance, I leave others to determine.

However, Mr. Maugham has not controverted a single point that I have asserted by any substantial arguments, nor has he established a single one of his own, except that which was his original position, that chemists are generally in error in speculating on the subject of iron. I think, if he had stuck to that he would have maintained his ground against all opposition; but I fear his new line of argument will not be so successful. If I might venture my advice, it would be the same as Dr. Johnson gave to a friend who accompanied him on one occasion to the theatre, and between the acts exercised his wit by braying like a donkey. The imitation was so good, as to call forth shouts of laughter and raptures of applause, which, stimulating the brayer to greater exertions, he successfully essayed to imitate the noises of other animals; but these proving failures, produced nothing but hisses. The doctor, concerned for the reputation of his friend, turned round to him, and said, with his usual gravity, "My dear sir, let me recommend you to stick to the braying."

And now, Sir, in conclusion, let me observe that, as in the days of chivalry it was usual for the combatants in a tournament, after fighting each other "teeth and toe-nails"—as our transatlantic brethren say—to pass their com-

pliments on each other's prowess, so, in breaking a lance with your correspondent Mr. Maugham, I should be sorry to omit so good a custom, and one to which (in sober seriousness) his abilities so justly entitle him. My weapon has not been I hope—certainly not intentionally—dipped in gall; and if it were, the reputation of my opponent stands too high to suffer from such a cause. (I must inform you, Mr. Editor, in a parenthesis, that I always use *patent ink*, in order that my writing may be free from *acidity*.)

I am, Sir, yours, &c.

London, Dec. 7, 1836.

C.

*On the Utility of Aerostation. By the EDITOR.*

MR. MASON, who accompanied Mr. Green in his late balloon excursion into Germany, has just published a detailed account of the aerial voyage, which strongly corroborates my observations in No. X., on the hopelessness of guiding balloons through the air. Animated and interesting as the picture is which Mr. Mason has drawn of the voyage, one cannot but see utter inutility standing prominently forward in every page that he has written.

What does the whole account prove beyond the simple facts known to every schoolboy, that by throwing out ballast the balloon's buoyancy is increased, and it ascends; on the contrary, by letting off the gas the buoyancy diminishes and the balloon consequently descends? As to guidance—the voyagers prudently resigned that to the caprice of currents they could neither coax nor command to their purpose, and therefore the less said on this subject doubtless it was thought the better.

But though the probability of directing balloons is desperate, still they may be turned to useful accounts in the hands of men of science. For example, we know but little experimentally of atmospheric currents, of the nature and formation of clouds, the rates of decrease of temperature, pressure, and humidity in the more open and elevated regions of the atmosphere. Now such experienced aeronauts as Mr. Green and Mr. Graham, aided by men of science with competent instruments, might soon extend our knowledge of these subjects, and convert an instrument of fruitless curiosity into one of real and substantial utility.

Meteorology for instance is a branch of science, the least perhaps of any understood. By means of a balloon, how-

ever, we may visit nature in every corner of her laboratory, witness her operations, and record them from personal inspection. If then it be true, as many able philosophers think, that the now uncertain winds and wandering clouds are caused and regulated by fixed and steady laws, we shall be in the fairest way to discover them. But suppose we could even attain such knowledge approximately, of what immeasurable advantage would it be to society! Who could calculate the benefits a pre-knowledge of the weather would confer on the farmer, or of the winds on the mariner, and, by our natural relations, on us all? Could we but have foreseen the late hurricane only for a single week, how much property might have been saved, and how many valuable lives to their respective families might have been preserved!

Again, we can scarcely open any of our books of astronomy, but we find them teeming with complaints of the imperfection of our theories of refraction, and all owing to the want of better acquaintance with the two or three elements I have named above. Now every man knows that accurate tables of refraction are the corner-stone of astronomy. Improve the one, and you necessarily improve the other, and by consequence navigation. From navigation the benefits spread immediately over commerce.

Thus might a machine, which is now a mere isolated and barren toy, be converted to the most important and valuable purposes.

But by extending our knowledge in the above cases, we may indirectly accomplish the very object the balloon goers are now seeking, namely, the making of it a travelling machine. For should we discover any constant or periodical currents in the lofty regions of the air with their limits of action, though we never could hope to oppose them, we may ascend or descend to them, and avail ourselves of their assistance to reach our destination pretty nearly, as ships now do with the trade and other winds.

EDITOR.

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### *Russian Railroad.*

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—A paragraph having made the round of the London newspapers prejudicial to the above undertaking, I beg, as the best means of showing the truth, you will do me the

favour to notice the following heads in contradiction to the misstatements therein contained :—

Firstly. This line is only the commencement of the grand line to Moscow, and was begun in April, partially opened with horses on the 9th of October, and publicly with locomotives on the 22d of November, all the Imperial family being present.

Secondly. By a census taken by Government, in 1834, the number of passengers passing between St. Petersburg, Zarskoe-Selo, and Pawlowsk, was 70,386, employing 178,187 horses. The experience of existing railroads shows that the number of passengers is equal to three times the population, which being 500,000, 1,500,000 might have been calculated upon, but only *one-fifth* of this number, or 300,000, have been taken as the probable total of annual passengers, producing 450,000 rubles, being 13 per cent. as compared to the cost and expenditure.

Pawlowsk, possessing the finest park in Europe, on which the Crown annually expends a million of rubles in improvements, is a place of great resort of the inhabitants of St. Petersburg; and to render it still more attractive, the company have erected a splendid edifice for public amusement within the park, of 350 feet frontage, containing concert and ball-rooms, conservatories, fountains, &c., and that it requires no manufactories to ensure the success of these eighteen miles of railway.

Thirdly. The line runs on an embankment on which it has been found the snow will not lie: the locomotives, however, are furnished with an apparatus to clear away the sleet and snow should such accumulate upon the road.

Fourthly. Mr. von Gerstner is well known in this country as a first-rate engineer, to be quite incapable of committing any such mistakes as asserted with respect to the repairing of the road.

I remain, with respect, Sir, your most obedient servant,

CHRISTOPHER KREEFT,

Agent to the St. Petersburg and Pawlowsk  
8, *Billiter Street*, Railway Company.

*Dec. 24, 1836.*

[We almost wonder Mr. Kreeft has thought it worth his while to notice the observations to which he alludes. The more splendid, and likely any project is to succeed, the more exasperated little minds are, and the more petulant malice it elicits. Men of sense consider the censures of the vicious almost as demonstrative of merit as the praise of the wise.

To suppose that such a man as Von Gerstner does not know what he is about, the country he is making his railroad in, and how to obviate any little difficulties there may be, is really too much. We heartily wish some of our wild schemes had success so obviously before them as this Russian railroad; and that the poor dupes who support them had their money in the Zarskoe-Selo Railway rather than where it is.—ED.]

*London, Rochester, and Chatham Railway.*

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—I wonder you have not noticed the above line, one of the greatest monstrosities that ever the human mind conceived. I at first thought it was advertised merely for a joke, to see how far human credulity could be drawn on; but, to my astonishment, I find the usual notices have actually been given for proceeding to Parliament. By some means I have mislaid my prospectus, but I believe this scheme is to run on the Eastern Counties line to about Romford, in Essex, and thence southwards across the Thames to Gravesend; afterwards to sweep nearly along the banks of the Thames, and come to the Medway a considerable distance—a half a mile?—below, or to the north of Rochester-bridge. Now, the idea of going into Essex for the purpose of reaching Gravesend in Kent, and crossing the Thames with a railway train where the river is perhaps three quarters of a mile or more wide at high water, and where it ebbs and flows from 20 to 25 or 26 feet, is so supremely absurd, so eminently wild, ridiculous, and mad, that no man who ought not to be an inmate of Bedlam could, in my opinion, have conceived it. Pray, Mr. Editor, is not this sapient project the invention of the Secretary of the Eastern Counties Railway? \*

Do give us a little information thereon, and tell us how the wiseacre proposes to cross the Thames, and get rid of the ebbing and flowing of the tide; for 20 or 25 feet are no trifle where every foot is of moment. Does he intend to bid the waters stand still, as Joshua did the sun? or will he part them with his wand, as Moses did those of the Red Sea, every time the trains have to pass?

\* We do not know; we have heard so: but if our correspondent means by this to insinuate that Mr. Robertson is become insane, we beg to say we have not heard of it; and indeed, poor man! we should lament to hear such an event very much.—ED.

I do not ask why the Rochester terminus is to be a half a mile below the bridge, where the Government neither can or will permit a bridge; for the reasons given to me are exceedingly good, very considerate, and perfectly unexceptionable. An eminent medical man's advice, it seems, has been taken, who asserts that railroad travelling is peculiarly injurious to the health, unless immediately counteracted by exercise. It is intended, therefore, for the able-bodied to walk this half or three quarters of a mile, and crutches are to be provided for the cripples, whips for the lazy, and asses for the incapable. They are to be regularly marshalled in order, and marched into Rochester like a gang of second-hand gypsies with banners flying bearing the appropriate motto of "Robertson's First or Second Class." Several Hanoverian girls are to be especially retained to enliven the way with pipe and tabor, playing and singing "Buy a broom," "Polly, put the kettle on," and "Oh! dear, what can the matter be."

Really, Mr. Editor, you do not do your duty in not promptly exposing such insults to common sense as this London, Rochester, and Chatham phantasma. It is these wild schemes which injure projects really good, and do so much disservice to the cause of railways. Hoping you will be more vigilant,

I am, yours, &c.,

PHILO-TAFFY.

### *A Lecture on Railroads.*

THERE are many of our useful possessions, with the sources in which they originated we are unacquainted. With some writers this is believed to be the case with language itself; while others contend it proceeded from our Creator, and was an appendage to our formation. Be this as it may, there are various modern inventions to which it is difficult to assign their authors; amongst others, we may mention gunpowder and the art of printing. The Chinese have claimed the introduction of both, and the Germans insist upon the title of inventors of the art of printing. Nor have our own countrymen omitted to bestow on Friar Bacon the honour of having manufactured gunpowder. Had they contented themselves with attributing to him an acquaintance with the several ingredients of which gunpowder is composed, their argument might be admitted; but that he understood the compound effect of the ingredients, is far from

evident. How prodigiously diversified have been the effects produced by gunpowder and the art of printing! War has changed its character, though its desolating consequences remain. The strength of a nation no longer depends on the number of its inhabitants, the nature of its fortresses, or the extent of its territory. Victory is no longer secured by manual exertion, but is more indebted to the use of instruments, the result of mental and scientific labour. Nor are the consequences of the introduction of printing less important. They were gradual. Block-printing preceded the adoption of metallic types. Stereotype is a modern improvement; and the art of lithography of a still more recent date. Who can enumerate the effects they have produced? Civilization has been substituted for barbarity; and the means have been multiplied for extending mental improvement, social comfort, religious knowledge, and Christian principles. Nor will their operation cease, till prophecy shall have its completion, in the sword being beaten into the ploughshare, and the spear into the pruning-hook.

There are other instances in more modern times, to which it is difficult to affix the name of inventor. I refer to steam, and to the person by whom steam received a direction to practical purposes: for it was long known that it possessed heat and expansion, before it was condensed, and its operations shown in air, earth, and metallic substances. That it could dissolve bodies, facilitate and diminish labour,—that it could produce uniformity and exactness to mechanical operations,—that it could aid in the manufacture of wool, silk, and cotton,—that it could benefit in the raising of the ore, and in the purifying and giving form and beauty to the metal,—that it could assist in the making of glass, of pots, of paper, and printing,—these were facts with which men of former days were ignorant. These are only a few of the results of the application of steam. The winds and waves witness its power. By the introduction of the steam engine the voyager is no longer subject to the delay which contending elements before occasioned; and the traveller by land is now no longer deterred from undertaking a journey to a remote distance. But with whom originated these inventions? Some assign them to the publications of the Marquis of Worcester; others to Captain Savary. These are questions we leave their respective advocates to discuss. Our object is to examine into the moral and political effects that will probably result from the general attention now bestowed on railroads. As might be expected, they have

their advocates and their opposers. It therefore has seemed to the lecturer, who has no interest in any of the numerous plans submitted to the public, desirable impartially to state the objections he has heard and read, and to subjoin such replies as candour and justice might furnish ; then to enumerate some of the arguments advanced by those who contend for the utility of railroad communications. This plan will combine some branches of political economy, without technicalities, and not on that account less deserving of attention. One suggests itself in the method adopted by the promoters of the Liverpool and Manchester railroad, before they commenced their operations, exciting competitions, by offering a premium for the production of the best engines.

The qualifications necessary for adoption being velocity with security, emulation was excited, numerous competitors appeared, the trial was fairly made, and the public benefit secured.—An example worthy of general imitation, not only in similar, but also in other concerns, in which the interest of society is involved. Competition and improvement are united ; favouritism and expense are generally combined. There is a neutral party in the instance we are considering. The objection such urge is against the number and extent of railroads. All they require is limitation. This must be left to the Legislature. No railroad can be adopted of a general nature, without full investigation, and the most ample means afforded for proving the probability of the scheme being productive of national benefit. To those who urge the bad tendency of railroads to excite speculation, a more copious answer must be given. The fact cannot be denied. How is it to be prevented ? Money is a marketable article. This day it assumes one form, to-morrow a different one. You cannot confine the facility of its changing hands, without endangering liberty, and checking commerce, on which the prosperity of the nation depends. And who objected to speculation in loans, when war required the advance of money ? Is it consistent to restrain its application in arts of peace ; or to censure those who would employ their capital in facilitating the saving of time, or diminishing the cost of the transmission of manufactures ? The objection is founded in error. It supposes there is no difficulty in finding proper methods of employing capital. Why then have such large sums been vested in foreign countries ? Some in loans, some in mines, some in estates. A large portion of American, Dutch, Spanish, Portuguese, and South American stocks belongs to Englishmen, not to mention French



and Belgians. This would not have been, had profitable investments been capable of being made at home. Instead, therefore, of railroads withdrawing capital, they will aid in its return to our own country. Capitalists well know how to employ their money to the greatest advantage. Besides, this informs us in what the difference consists between a speculatist and a capitalist. The one seeks for exchanging, the other for giving permanency to his property. It is granted, that till railroads are completed, or in part fitted for use, no interest can be obtained from the investments. But this forms a necessary part of calculation previous to the purchase of shares. This is common to the buyers of ships, of estates, or of factories. Arguments are to be weighed by the extent of their application, as well as by the form in which they are urged. Without this, hasty decisions will be substituted for solid judgment. Another objection is often advanced against railroads, the depreciation they will occasion to canals, turnpike-roads, and stage-coach proprietors. The fact must be admitted\*; but, as in the former case, its general bearing must be examined. Supposing the case to be common to all, which may be questioned, how does this vary from any other investment of capital in the kingdom? As members of a community, we must partake of the changes which the community experiences. For instance, if a new and nearer road be opened, the proprietors residing near the old road may suffer a loss; but will the public be injured? Sometimes a new method of manufacturing articles is introduced, by which those accustomed to the former process are materially affected; but the price is reduced, the demand increased, and the consumer benefited. This has occurred in the woollen trade, deserting the places in which it was first established, and choosing a remote station, in which coal and water-carriage could be more easily obtained. Witness Ipswich, Bury, Newbury, and Reading. Norwich has experienced various transitions from its camlets and bombazines, to shawls, silk, and a mixture of silk and cotton. These are effects necessarily connected with freedom of trade. And what wise man would endeavour to lessen their operation?

One fact, and that of recent occurrence, may suffice to

\* Our worthy correspondent is, we believe, here mistaken with regard to canals. Experience has proved, that railroads do rather aid, not injure them. The reason seems to be, that railroads increase intercourse and commerce, and that, not being able to compete with canals in carrying heavy goods, the increase they create in such articles goes to the account of the former. See Evidence on the Birmingham line.—Ed.

confirm this statement. In the manufacture of paper less time is now consumed in the process than was formerly, in the difference of days and months. What in the old plan required three or four months, does not now demand an equal number of days. What has been the effect? The former buildings have become useless, the capital of the proprietors injured; but the public have the price of paper lowered, the certainty of supply secured, and science demonstrating the aid it can impart to manual labour. Wherever machinery is introduced, great changes follow, both to the employer and the employed. This is one cause of the migration both of trades and inhabitants; and will account for the prodigious increase of population in Lancashire and Yorkshire. There is another objection to railroads much insisted upon, especially at public meetings,—the invasion of private comfort, by exposing buildings and retreats intended for seclusion, to public gaze. That such instances may exist, must be allowed. Yet who will doubt that private convenience must yield to public benefit? Nor are we to forget that such instances are as much as possible avoided, not only to preclude opposition, but also to lessen expense. For it is to be recollected that compensation is given, and this generally with reference to relative, as well as intrinsic value. Besides, similar difficulties were urged when turnpike-roads and canals were introduced; and their utility is not now disputed. In some pamphlets another objection has been advanced against railroads, from the diminution of the land capable of producing hay or corn. This will be its immediate operation; but the ultimate effect is also to be considered. It is by comparing the loss with the gain that a correct balance can be drawn. Comparison can now only be applied, and a reference made to the effects produced by the formation of good roads and canals on our agriculture and commerce.

It is to past periods we are to refer. Who that does this with impartiality will not be convinced of the vast advantages now possessed for promoting inquiry into new methods, for advancing private interest and increasing national wealth? What would have been the present state of Lancashire and many parts of Yorkshire, if canals had not been introduced? What too the condition of our coal and mining districts? But to enlarge is unnecessary.

There was another objection urged when railroads were first discussed, now seldom mentioned. It shall, however, be stated. It was asked, what will become of the labourers

engaged in the formation of railroads, when they are completed? They will have no means of employment, and be dangerous to the community. Prudence is a virtue; but the anticipation of evil is not the mark of a strong mind. When the Manchester and Liverpool railroad was finished, no redundancy of labourers was found. A nobleman in erecting a mansion, or a manufacturer in making a factory, does not ask the builder what will become of the labourers when the present undertaking is completed. Numbers will be wanted to repair, to clean, and to attend to the engines employed; and new stimulus will be afforded to invention, and consequently increased demand for artizans of different kinds. I am not aware of any other objection that is entitled to remark; and since this lecture was composed, a most instructive publication has appeared, under the title of the *Railway Magazine*.

Had I previously known of its existence, I might have availed myself of information that might have rendered this lecture more interesting.

We now proceed to examine the arguments of those who contend for extensive benefits to be obtained from the introduction of railroads.

(To be continued.)

*New Plan of Bricks for Chimneys.* By LEWIS  
GOMPERTZ, Esq.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

*Oval, Kennington, Dec. 10, 1836.*

DEAR SIR, I beg the favour, through the medium of your valuable periodical, to describe a sort of bricks which has suggested itself to me, calculated, I think, to give much greater strength to chimneys, &c. than at present, and prevent the frequency of the terrible accidents of their being blown down.

These bricks are of a long rhomboid or diamond shape, instead of oblong, [parallelopiped ?] and thus interlock, like the teeth of two straight-toothed saws would do; instead of forming parallel lines of mortar, which are easily broken.

Even with common bricks a stronger mode of using them in chimneys, &c., may be adopted than the common way, which consist in placing the bricks end-wise, instead of horizontally, and placing a long brick and a short one toge-

ther, so as to produce a zig-zag of mortar transversely, and straight like perpendicularly,—the very reverse of what is now done. It is indeed a matter of surprise, that when two methods equally easy present themselves, the wrong one should be universally adopted from one builder to another, as if men had nothing to do but to copy each other, without exerting a thought of their own. An ingenious plan of bricks producing greater strength than common ones, has also been invented by Mr. Cartwright, and is described in the Repository of Arts, but is different to the above plan.

I remain, Dear Sir, yours very truly,  
LEWIS GOMPERTZ.

## MISCELLANEOUS AND SCIENTIFIC INTELLIGENCE.

*M. Limpkins's Experiment on Light.*—An experiment has been recently described by M. Limpkins, (Journal of Science, No. XLV. p. 168.) in which coloured rings or halos are produced round a flame or luminous object, by the following means:—A glass globe containing a little water, has a quantity of air forced in through a stop-cock, and the aperture being then alternately closed and momentarily opened, at each change so produced in the pressure of the medium over the water, the colours are displayed round the flame seen through the middle of the globe. M. Limpkins supposes the effect due to the difference of aqueous vapour which the change of pressure allows to be formed, and offers some conjectures on the physical constitution of the vapour, which appears to us, we must own, very unsatisfactory. We should be strongly disposed, *a priori*, to ascribe the effect to the almost invisible condensation of vapour on the glass, which is well known to give rise to such colours, and to be perfectly explained on the principles of interference.—*Thomson's British Annual*. [We have great doubts on the existence of this supposed interference, and think we can explain every experiment hitherto made, very satisfactorily without it. Ed.]

*Magnetic Mountain.*—A tradition of very ancient date still exists amongst the Chinese, respecting a mountain of magnetic ore \* rising in the midst of the sea, whose intensity of attraction is so great, as to draw the nails and iron bonds with which the planks of a ship are fastened together, from the places with great force and

\* European writers in general, attribute the history of magnetic mountains to the Moors; and reference to the supposition may be found in those even of the 17th century.

cause the ship to fall to pieces. This tradition is very general throughout all Asia, and the Chinese historians assign its position to a specific place which they call Tchanghai, the southern sea, between Tonquin and Cochin China. Ptolemy, also, in a remarkable passage in his geography, places this mountain in the Chinese seas. In a work attributed to St. Ambrose, there is an account of one of the islands in the Persian gulf called Mammoles, in which the magnet is found, and the precautions necessary to be taken (of building ships without iron) to navigate in that vicinity is distinctly specified. In two passages of the work of the Arabian geographer, Cherif Edrisi, and in a remarkable one in the Apocryphal Arabian translation of the "Treatise on Stones," attributed to Aristotle, it is again specifically stated; it also occurs in Vincent de Beauvais, a French writer, who had been in the holy wars; and, after his time, in a great number of European writers. A circumstance remarkable enough, is, that the Chinese writers place this magnetic mountain in precisely the same geographical region that the author of the voyages of Sinbad the Sailor does.—*Ibid.*

*Grass Oil.*—This is a fine volatile oil from Calcutta; its colour is amber—its smell strongly resembling that of *Kayooopooti Oil*. It begins to boil at 120°, and the thermometer continues to rise above 370°, the oil boiling all the time. Sulphuric acid forms a fine crimson acid soap with it, which soon however, becomes dark coloured, and the oil remains. It burns readily, giving out much smoke. It is applied to various economical purposes in India, although the writer is not aware what these are, nor from what plant it is obtained.—*Ibid.*

*Tea Oil.*—This beautiful vegetable oil the writer procured during a visit to China in 1832; it has hitherto been merely noticed by two travellers in China, but the writer is not aware that any specimen has reached Europe; it is certain, at least that it has escaped the notice of chemists. The Chinese term it *cha yew*, or, in English, tea oil. According to Dr. Clarke Abel, it is procured from the seeds of the *camellia oleifera* by expression; these are introduced into the hollowed trunk of a tree, and are forcibly compressed by means of wedges driven in by a battering-ram, which acts horizontally. From a careful examination of various seeds of different species of tea and camellia plants obtained from a merchant in Canton, the writer is disposed to think that the seeds of the various species of camellia and tea plants afford a similar oil—they are all equally oily and similarly constituted—the dissepiments of the capsules in all are thin and ligneous, the seeds are covered with a thin brown nucaceous envelop which is beautifully traversed on its interior surface with aboriferous, nutrient vessels. When the nut is ruptured, the true seed or kernel is discovered equal in size to a pea, sub-globular, and much wrinkled and pitted: a transverse section exhibits the yellow or cream colour of its waxy interior substance, which possesses a strongly bitter taste. The specimen

examined possesses the following properties, as described by the writer in a paper, now before the Royal Society of Edinburgh. Its colour is pale yellow, and at the ordinary temperature of the atmosphere it is liquid. In winter it becomes thick, like olive oil; its specific gravity is 927. The writer endeavoured to ascertain its boiling point, but without success; at the temperature of  $100^{\circ}$  the fluid began to be thrown into motion by internal waves, gradually moving upwards; at  $250^{\circ}$  several bubbles formed at the bottom and were soon detached; at  $260^{\circ}$  the internal motion was increased in some degree; at  $300^{\circ}$  vapour began to come off visibly, and the odour of the oil was apparent in it; at  $440^{\circ}$  the vapour was given off abundantly; at  $500^{\circ}$  the oil became dark coloured and lost its transparency; at  $600^{\circ}$  it still continued without boiling, when the mercury rose to the top of the scale  $720^{\circ}$ , and it was necessary to terminate the experiment.

This and various other experiments have led the writer to doubt whether any vegetable oils have a stated boiling point; experiment would lead us to the conclusion that they consist of mixtures of oils which boil at different temperatures, because we often observe that the mercury continues to rise long after ebullition has commenced—oil of turpentine may be cited as an instance—and it was found to occur in one specimen of tea oil examined. It consists of oxygen 9,852, carbon 78,619, hydrogen 11,529—this is equivalent to  $O+10\frac{1}{2}C+9\frac{1}{2}H$ , or it may be considered as a compound of one atom carbonic oxide and  $9\frac{1}{2}$  atoms of carbydrogen. This oil burns well, affording a clear flame without smoke, and is extensively used in China for this purpose; in the same country it is employed as an esculent oil: immense quantities of it are consumed in this way, most of the boats of any considerable size on the Canton river being supplied with it. Its taste is agreeable, and hence it might be conveniently substituted for the Florence oil which is used for salads in this country. In this respect it would be especially serviceable to our eastern colonies. Its price, also, which was as low as a dollar a gallon in 1832, and probably might have been lower, if any attention had been paid to the purchase, recommends it to the consideration of importers of such articles in this country.

*Extracts from a Log Book, of May, 1835.—Cape Coast Castle and the King of the Ashantees.*—During my stay at Cape Coast I had an opportunity of visiting the interior of the Castle and town; the former is a remarkably strong and well-built fortification, it is situated on a rock projecting into the sea, two sides being open to the roads, and presenting each a formidable battery of twenty guns—32 and 56 pounders. That part of the building which faces the town is the most conspicuous, the splendid apartments of the Governor and principal officers are here exposed to view, also the chapel and Secretaries' offices are distinctly seen. The whole edifice, being white-washed, has a beautiful appearance from the road and town.

This part is defended by 60 pieces of cannon and a few mortars. On one rampart Mr. D——, my guide, showed me 60 human upper jaw-bones, sent as a present to the Governor, from his Majesty the King of Ashantee. This prince is a most cruel, depraved, character; every morning before breakfast he bathes his feet in human blood (warm); frequently for his amusement, men, women, and children are flayed alive, and thrown into a spacious cavern at the back of the town.

The town of Cape Coast is very large, in rather a circular form, some of the streets are regular and at right angles with each other, but the houses of the negroes are miserable mud—I call them pigsties—in heavy rains many are completely washed away. The women expose kankee, fruit, vegetables, palm wine, and fowls, for sale. I was present one day at this beautiful exhibition.

The houses of the merchants are beautiful buildings, each is surrounded by spacious gardens, well stocked with all the native productions of the climate, cocoa-nut, tamarind, oranges, shaddock, and palm-trees, I noticed were most plentiful.

The greatest evil of this place is its being so much infested by wild beasts and venomous serpents; the burial ground resounds at night with the yellings of hyænas, which will even tear open new made graves; the natives never venture out at night without a lighted torch, with that a person is pretty secure.

Mr. D—— told me that returning one night from the Castle he observed at his garden-gate, prowling about, two tigers; the black boys who attended, in their fright shouted, which, with the glare of the torches, frightened the animals away. Mr. D—— also showed me a snake, called the *cobia de capella*, preserved in rum, which his boys had found and killed in his bed-chamber.

Between the burial ground and the town is a venerable looking tree; it is death to any white man, to cut this tree, or to pluck the leaves from it; it is the negroe's Fetish, and many thousands of human beings have been sacrificed under it to their deity.

*A Little Fright*—Noon, pleasant weather.—I went ashore on the Island with the carpenter to cut a spar to make a fore-royal-yard, having sprung ours. The Island is low, and in many places marshy—pine-apples growing wild in abundance; I gathered a dozen beautiful ones. While we were rambling among the trees in search of a stick a rustling noise among the leaves of a cabbage-tree induced us to look up, when I beheld with feelings not very pleasant a large green snake; I fancy it was in search of monkies, but fearing it might feel inclined to make acquaintance with us, we took to our heels and made all sail for the boat. On the beach we found a stick to answer our purpose, cut it, and proceeded on board.

*Falling Stars.*—The phenomena of these bodies have excited an intense interest among the philosophers of France, as being likely to open a new feature in our Solar system. At the sitting of the

Academy of Sciences on the 28th of November, M. Arago gave an analysis of several letters received by him on the subject. At Paris, in the night of November the 13th, 170 of these bodies appeared from 6 h. 48 m. in the evening, to 6 h. 35 m. in the morning. At Bury there were 120 from midnight to 6 h. A. M. In other places they followed the same proportion, and generally passed through the constellation Leo, or described lines which, produced, would pass through it. On the morning of the 13th of November, the peasants in the environs of Tours declared that it rained fire during the night; and in the valley of the Rhone, near Culloz, these bodies followed each other with such rapidity that the people who saw them through a fog, imagined them to be lightning proceeding from a storm, or, that it was the re-production of the brilliant Aurora Borealis of the 18th of October.

The celebrated M. Biot read a long and interesting memoir on this subject at the Academy's sitting on the 5th of December. The substance of it was, that the earth, about the 13th of November, was near the zone of the solar nebulosity, which is supposed to constitute the phenomena known to astronomers under the name of the zodiacal light; that it is possible this meteor may be particles of the nebulosity met with then, disturbed, and even in many instances brought to the earth by its powerful attraction. As the inferior planets Venus and Mercury twice in their revolutions about the sun pass through dense parts of this nebulous matter, he thought it possible they would occasion greater disturbances, and that some of the straggling particles so disturbed may be the shooting stars of other parts of the year. Every part of the memoir was well supported by facts and arguments. We have only to observe, that if the cause advanced should turn out to be true, the solar system contains inhabitants never before dreamt of, and which will cut out work for astronomers for many years to come.

#### ON THE SOLIDIFICATION OF SILVER IN FUSION.

The following interesting account of some experiments on the solidification of silver in fusion, we copy from the *Mining Journal* of December 3d. We have ourselves, since seen a specimen in a plate of silver of 1500 oz. made in refining pig lead at the works of Messrs. Walkers, Perkin, Walker and Co., at Newcastle, and the description here given is most faithful. We have also been assured by one of the firm, that the phenomena were precisely as described in the account. We, however, by no means agree in the inferences drawn respecting the once greater heat of our earth. We think we are in possession of much sounder philosophical principles, and can mathematically demonstrate from phenomena the contrary.

Since writing the above we have seen at Messrs. Savory and Co.'s, Silversmiths, Cornhill, the above piece of silver cut transversely across the highest ridges of it. The whole of what may be called the natural level or bed of the silver was solid, but the parts that



had been raised up, which were two inches elevated in some places, though much more solid than we expected to find them, yet, towards the upper portions particularly, contained several hollow spaces, some of them from one to two inches in length and breadth and half an inch deep, arranged chiefly horizontally, and presenting fine miniature specimens of caverns, and those vast receptacles, philosophers have imagined to produce the phenomena of natural intermitting, and reciprocating springs.—Ed.

*The Result of the Experiments of M. Furnet, as applied to his new Theory of Volcanic Formations.*—By the experiments of Messrs. Lucas and Guy Lussac, it is found that silver in a state of fusion, and exposed to the atmosphere, absorbs oxygen, and on becoming solid, gives it out again. The quantity of this gas thus absorbed may amount to twenty-two times the volume of the mass of silver; and to its evolution is to be ascribed the apparent ebullition observed by assayers. Hitherto no attention has been paid to the remarkable circumstances attending this process, when the experiment is conducted on a somewhat larger scale.

Having had occasion frequently to refine, in small reverberatory furnaces, silver bars of forty to fifty pounds weight, I can warrant the following as correct results, when the silver is sufficiently fine, and the cooling gradual. The solidification commences at the edges and advances towards the centre, and the silver when passing from a fluid to a solid state, experiences a very slight agitation or ebullition, and then becomes motionless. Matters remain thus for a short time, to all appearances perfectly tranquil, when suddenly a part of the surface becomes irregularly perturbed, fissures appear in one or several lines, from which flow, in different direction, streams of very fluid silver, which increase the original agitation. The first stage does not yet clearly manifest the presence of gas, and seems to arise from some intestine motion of the particles in their tendency to group on entering the process of crystallization, and thus causing the rupture of the envelop, or external crust, and the ejection of some liquid portions.

After remaining some time tranquil, the metal presents a fresh appearance, precisely analogous to volcanic phenomena. As the crystallization continues, the oxygen gas is given out with violence, at one or more points, carrying with it melted silver from the interior of the surface, producing a series of cones, generally surmounted by a small crater, vomiting out streams of the metal, which may be seen boiling violently within them.

These cones gradually increase in height by the accumulation of metal thrown up, and that which becomes consolidated on their sloping sides. The thin crust of metal on which they rest consequently experiences violent impulses, being alternately raised and depressed by such violent agitation, that were it not for the tenacity and elasticity of the metal, there would evidently arise dislocations, fissures, and other analogous accidents. At length several

of the craters permanently close, while others continue to allow the gas a passage. The more difficult this is, the more the craters become elevated, and the more their funnels contract by the adhesion or coagulation of a portion of the metal. The projection of globules of silver now becomes more violent; the latter being carried to great distances, even beyond the furnace, and accompanied by a series of explosions, repeated at short intervals. It is generally the last of these little volcanoes that attains the greatest altitude, and exhibits the foregoing phenomena with the greatest energy. It is moreover observable, that these cones do not all arise at the same time, some having spent their force, when others commence forming at other points. Some reach the height of an inch, forming bases of two or three inches in diameter, and the time occupied by this exhibition is at least half to three quarters of an hour.

During the formation of these cones, by the evolution of gas, portions of silver are shot forth, which assume on induration, a form somewhat cylindrical, and often very fantastic, notwithstanding the incompatibility which appears to exist, between the fluidity of the silver, and these elongated figures. Their appearance is momentary, and without any symptoms of gas, although it is impossible to decide whether they may not arise from its influence; they seem, in fact, to resemble the phenomena of the first volcanic period.

These ebullitions, which continue until the metal is completely solidified, appear to me identical with geological phenomena; not a single feature of resemblance is wanting, the rising and falling of the surface, perturbation of the soil, fractures, fissures, volcanoes with craters, evolution of gas, and ejection of streams of lava, all these present a remarkable similarity, the difference consisting only in the dimensions.

From the above observations, we may deduce the following comparative results:—

The mass of the globe, as it has been demonstrated by the labour of modern geologists beyond a doubt, was at first in a fluid state, like the silver in question. In consequence of this igneous fluidity, favoured besides by the atmospheric pressure, the earth has absorbed the gases surrounding it. Those possessing powerful affinities, such as oxygen, &c. have combined directly with a portion of the metals and metalloids, and remain united with them; but such as possess only weak affinities, have remained for a longer or shorter period simply condensed, being then emitted at various intervals, and at different points, and will continue to be so given out until the whole mass in which they are contained in solution shall be solidified, in the same manner as the air combined in water becomes disengaged from it during crystallization or freezing.

In the process above described, the oxygen exhibits too little affinity to remain united with the metal. In the corresponding

phenomenon on the terrestrial globe, it is carbonic acid and aqueous vapours which are the most active agents; and consequently we find them abounding in all volcanic regions, whether the volcanoes be in activity or not.

Among the gases evolved, azote but rarely occurs. Does this proceed from its being overpowered by too great a surrounding mass? Has it more generally formed combinations producing the results observed in mineral waters, &c.?

Finally, in these phenomena, has the terrestrial mass in fusion, shown a preference for other gases, to the exclusion of nitrogen; as the melted silver in the furnace exhibits no tendency to unite with carbonic acid, or other gases resulting from combustion? I leave geologists to decide these questions.

On the other hand, nitrogen may be disengaged more rapidly than other gases; as copper gives out sulphuric gas before its solidification, and then undergoes a violent ebullition.

The enormous quantity of carbonic acid continually arising in volcanic districts, either with or without mineral waters, might be adduced as evidence of the ancient state of the atmosphere; so rich is this gas, that M Brongniart attributes to it the vigorous vegetation of the primordial ages; and the circumstances attending the refining of silver, all denote an atmosphere abounding in oxygen.—*Treatise on Geognosy, by M. de Voisin, vol. iii. p. 277.*

## REVIEW OF BOOKS.

*Thomson's British Annual.*—BAILLIERE, Regent Street. The first volume of a very useful publication under the above title, on the principle of the French, *Annuaire*, and containing a vast deal of useful information, has just been published. The articles on various branches of science are written by men of established reputation, and contain very good accounts of the recent progress and present state of the sciences they treat of. In our *Scientific and Miscellaneous Intelligence* we have made some extracts, which will show the nature and character of the work better than any words of ours.

*Fisher's Views in the Holy Land.*—These attractive numbers we are glad to find are spreading far and wide. There is scarcely a person of taste within our knowledge whose tables we do not find them ornamenting. The views it is true tell the tales they are intended to do singularly well, but we could wish the letter-press contained more of the history, manners, and customs of the inhabitants.

*Yate's New Zealand.*—Some theories are so ingeniously supported that they mislead those by whom their effects are not duly considered. Such were the reasonings of Rosseau. It was left to

experience to ascertain their futility. This hath been fully accomplished by those who have visited the Caffres, the Hottentots, the Polynesian Islands, and New Zealand. To such publications as Capt. Gardiner's, Mr. Ellis's, and Mr. Yate's, we may refer for proving the difference between civilized and uncivilized societies. To the last-mentioned, our observations shall be confined. Mr. Yate has given an account of the climate, production, animals, and rivers of New Zealand. He then details the customs of the natives previous to their reception of Christianity, and afterwards states the result of their becoming Christians. He enumerates the difficulties with which the Missionaries had to contend, and explains the method by which they were overcome. The style is plain, the facts are important, and are calculated to be useful, especially to those who may engage in the same work and labour of love. A spirit of piety and benevolence pervades the whole of the publication; we therefore can recommend it to our readers.

M. D'AVERAC has published an interesting sketch of the neighbourhood of Algiers, and presented a plan by which a more correct knowledge may be acquired of the geography of Africa than we now possess.

It will be gratifying to many classical students, to find a modern publication entitled "*La Compania Sotherrania*," by G. SAUCHER, elucidating many obscure passages in Homer, Virgil, Strabo, and Seneca.

## PROGRESS OF RAILWAY WORKS.

*Birmingham and Gloucester Railway.*—We learn that this Company have commenced operations. At Northway, near Tewkesbury, excavations and cuttings have been in progress for some time; and the land over which the line is to pass between this city and Gloucester, is for the most part staked out.—*Hereford Journal*.

*Bristol and Exeter Railway.*—We are happy to state that the Bristol and Exeter Railway is proceeding with great vigour. Two contracts, together amounting to nearly eleven miles, were lately let at Bristol. Both contracts are signed for, at prices far below the estimates which the Company laid before Parliament, and not a doubt exists that the first thirty miles from Bristol will be executed 30 per cent. below those estimates. The point at which the second contract terminates, is within the verge of the remarkable and uninterrupted level which the line traverses to a distance of less than four miles from the town of Taunton. The Bristol and Exeter is the only railway incorporated during the last session, which has hitherto contracted for the commencement of actual operations. It is satisfactory to add, that the Company have no

need to go to Parliament for leave to effect a single alteration. Mr. Gravatt, the engineer, is now actually engaged in making final arrangements for another contract, which will extend from Exeter through the valley of the Exe to Stoke Canon.—*Taunton Courier*.

*Greenwich Railway*.—This line was opened by the Lord Mayor, from London Bridge to Deptford, December 14th. About 2,000 ladies and gentlemen were present, and between 400 and 500 sat down to a dinner afterwards. At a few minutes past one o'clock the arrival of the Lord Mayor was announced, amidst the loudest acclamations of the spectators. The Right Honourable Magistrate was preceded by the Chairman, Directors, and officers of the Company, after whom came the Sheriffs and other civic authorities. Some routine formalities being concluded, the Lord Mayor and suite were conducted to the carriages reserved for them in the first train. Four several trains were then put in motion, and passed in review before the Lord Mayor. The average rate of speed down to Deptford did not exceed from 15 to 20 miles an hour, and the several carriages arrived there a quarter before three. On reaching Deptford the Lord Mayor inspected the workshops of the Company under the Deptford station; walked from Deptford High-street to the Ravensbourne, where his Lordship inspected the bridge over that river, and also received a deputation from the inhabitants of Deptford and its vicinity, who waited upon him with an address, to which his Lordship returned a suitable reply. During the whole way back to London there was a gradual increase of velocity, varying from 15, 20, 25, to 30 miles an hour. The band of the Scots Fusileer Guards attended at the London station, and that of the Coldstream Guards at Deptford, and enlivened the ceremony with popular and national music. Though the arrangements at the railway were any thing but judicious, the day passed off without any accident, notwithstanding the immense concourse of persons assembled. Several of the engines bore the names of the gentlemen who have most distinguished themselves in the prosecution of this work, as Walter, Twells, Dottin, &c. We thought this in good taste; but we should have liked better to have seen something more permanent in the shape of monuments. Probably, however, we shall have them in the triumphal arch. The jolly John Bull figure of Walter would look well smiling down on the trains and in the act of enthusiastically thundering out, "VIRES ACQUIRIT EUNDO."

*Completion of the Great Viaduct on the Grand Junction Railway*.—On Friday, the 9th ult., was performed the ceremony of laying the last, or key stone, of the magnificent viaduct across the Weaver at Dutton. A party of the Directors from Liverpool attended, and were met by Mr. Locke, the engineer, and the resident engineers and contractors on the line. Mr. Heyworth, as the senior Director present, after placing the last stone in its bed, addressed the party present. He congratulated the workmen, of whom about one hundred and fifty were present, on their steady

perseverance and diligence in bringing to perfection so noble a work ; and the contractors for their assiduity and skill in its execution. He rejoiced to find that in the erection of this, the greatest and first structure of its kind in the kingdom, no life or limb had been sacrificed. Mr. Locke, the engineer, and the Rev. W. Stanhope, also addressed the meeting. The health of the workmen was then given by Mr. Locke amid hearty cheers. In the evening the viaduct was illuminated with torches, and fireworks were displayed in great abundance, during which time the workmen were regaled with a good dinner and excellent cheer.—*Chester Courant*.

*Midland Counties Railway*.—The engineers of the Midland Counties Railway have now marked out the whole of the line between the towns of Leicester, Nottingham, and Derby. Commencing about two miles south of Leicester, at Knighton Spinney, it passes this town in a curving line, through the Freeman's Piece, (where a short tunnel is guaranteed to the freemen, in order to preserve the entirety of the common as a grazing pasture.) Crossing beneath the Welford road, at the commencement of the acclivity, and passing beneath the New-walk and London road, the levels of which, we believe, will not be disturbed, it runs off from the latter place in a straight line towards Barkby, passing to the east of Thurmaston Lodge, the residence of Mr. Heyrick ; from whence, with a great curve, it sweeps to the west of Syston, crossing the Melton road at the windmill, and piercing the high banks of the Wreak near Syston mill. From the latter point, a straight line runs to Sileby, through which village it passes by the old manor-house. From thence, an insensible curve sweeps by the lime-kilns, and through the village of Barrow ; and then along the side of the cliffs which overhang the Soar. At an angle of the river, near the navigation-house, it crosses into the flat grounds surrounding Loughborough, touching the latter place at the last houses on the Nottingham road. Continuing in the same direction, and making a short cut across the Loughborough meadows, it again crosses the river, and enters the slightly elevated ground on the east of Normanton. With gentle curves, and inconsiderable elevations, it next reaches Sutton Bonnington, and passes close to the old dilapidated church of Saint Anne's, where consecrated ground has not deterred the engineer from taking his "best line" beneath the very walls of the sanctuary. Emerging from the cutting through the rising ground on the east of Sutton, with a low embankment, it traverses Mr. Strutt's meadows at Kingston, on the west of Mr. Stokes's house : and then, passing to the east of Ratoliff, it plunges into the heart of Red Hill, a singular escarpment of red marl and gypsum, which, with picturesque boldness, looks down upon the Trent. Here, the river being crossed by a bridge of considerable dimensions, the lines diverge, on the one hand to Derby, on the other to Nottingham ; these diverging lines being

again connected, so as to make the line between these important *termini* complete in itself. This portion of the line will be nearly horizontal, and the gradients of the whole highly favourable for the use of locomotive engines: more so, we are informed, than those of any line of similar extent in England. The distance between Leicester, Nottingham, and Derby, by the railway, will be nearly the same as by the present road: that is to say, the distance in *space* travelled over in point of *time*, which must henceforth be an essential element in the computation of distances—the difference will be as three to one, and the transit between the remotest of these places will rarely occupy more than three quarters of an hour. The rate of travelling on the Manchester Railway, is, upon an average, 26 (20?) miles an hour; but the speed upon a railway with such considerable inclinations as 1 foot in 96 feet affords no criterion for estimating the rate of travelling attainable upon a more perfect line, such as the *Midland Counties*, where the greatest inclination will be about 1 foot in 500.—*Abridged from the Leicester Chronicle.*

*Newcastle and North Shields Railway.*—The works of the Newcastle and North Shields Railway will be commenced in a few days. The two bridges across the Ouseburn and Willington Dean are both contracted for, and a considerable portion of the cuttings and embankments on the line.

*South-Eastern (London and Dover) Railway.*—In our last number we omitted to notice the proceedings of the first General Meeting of the Proprietors of this undertaking, which was held at the office of the Company on Thursday the 10th of November last. The meeting was very fully attended, the utmost harmony prevailed, and several proprietors locally interested in the line, took part in the proceedings. The Company have advertised for contracts for fencing off and setting out the line; and active preparations are being made for the commencement of the works immediately after the close of the present year.

## CONTINUOUS BEARINGS.

Mr. Vignoles, in a report to the Midland Counties Railway Directors, proposes to have continuous bearings on timber, using cast or wrought iron rails nailed or spiked down on it. A great improvement of Mr. Vignoles is to have the timber "half baulks Kyanized." Mr. V. refers in the report, to eighteen months' experience of continuous bearings on the Dublin and Kingstown Railway in proof of their utility. No man, we think, can for a moment question this, the advantages are too apparent. The following is Mr. Vignoles's

estimates of the costs and advantages, which we think will prove at the present moment peculiarly interesting.

*The following is a comparative Abstract of the total Cost per Mile of a Railway according to the several preceding stated Methods :—*

	Per Mile of Double Tracking.
Ultimate cost under the present system of a railway, laid on stone blocks, with 62lbs. wrought-iron rails, after replacing one-third assumed to have been temporarily laid on larch sleepers in the first instance . . . . .	£ 5,666
First cost of a railway wholly laid on stone blocks with similar rails . . . . .	5,456
First cost of a railway laid two-thirds on stone blocks and one-third on larch sleepers with similar rails . . . . .	5,192
First cost of a railway wholly laid on larch sleepers with similar rails . . . . .	4,664
First cost under the proposed system of a railway laid on longitudinal baulks of Memel timber, with 48lbs. wrought-iron rails . . . . .	3,879
Ditto ditto with 45lbs. wrought-iron rails . . . . .	3,762
Ditto ditto with 42lbs. wrought-iron rails . . . . .	3,637
Ditto ditto with 48lbs. cast-iron rails . . . . .	3,432

It will thus be manifest that there is an economy varying from 800*l.* to 2200*l.* per mile, and that the most disadvantageous comparison of the proposed with the present system, exhibits a saving in its favour equal to once wholly removing the longitudinal timbers, while taking the 42lbs. wrought-iron rail, which if wrought-iron should be preferred, I recommend as quite sufficient, and comparing it with first cost of a railway wholly laid on stone blocks, there is an actual saving of 1800*l.* per mile, or comparing it with a railway laid two-thirds on stone and one-third on larch sleepers, there is a positive saving of upwards of 1500*l.* per mile in the first instance, and an ultimate saving of full 2000*l.* per mile.

## RAILWAY NOTICES.

*Brighton Lines.*—The plans, &c. of all these lines, except Mr. Gibb's, we hear were deposited with the clerks of the peace, agreeable to the standing orders. It is reported that this gentleman was five minutes too late in one instance; his watch, perhaps, got tired, and treacherously lagged behind. However, we shall be sorry if accident has prevented him from having a fair chance.



The plans not having been deposited at the private bill office, we can say nothing of the respective merits of these lines.

The South-Eastern Brighton is to take a new route altogether, leaving the Croydon line, and coming up directly to Kennington Oval. They expect in getting over a gap 120 feet lower, near Godstone, very materially to improve their Dover line.

Sir John Rennie, it is said, fires this time with greater weight of metal. Report says that the Great Goliath of the Stock Exchange, Mr. Goldsmid (Gold Smith?), has lent him his long pocket pistols—very formidable weapons.

Mr. Stephenson's party must be in a fog, for we cannot see them, and can hear nothing but confused noises. However, having a Wizard for their guide, they will not lose themselves directly.

The directors of Cundy's line are grown uncommonly bold in the goodness of their line. We have heard of their having challenged all the rival lines to exchange plans and sections now, in order to give their opponents time to pick holes if they can. This is new and daring conduct. We hear the challenge has been accepted by all except their nearest neighbour, Stephenson's Committee.

*Ease of Draught on Railways.*—"Two horses drew the immense load of two hundred and sixty-three quarters of grain from Dalkeith to Edinburgh, on the Edinburgh and Dalkeith Railway, a distance of six miles. The weight of grain was about forty-four tons, and the weight of the waggons ten tons, making a gross weight of fifty-four tons!"—*Keen's Bath Journal*. [Why the whole direct draught was only 432lbs., which one horse ought to have drawn if the road is level.]—ED.

*Eastern Counties Railway.*—An injunction was obtained on the 23d of December against this company before the Lord Chancellor, to restrain their entering on Lord Petre's lands until after they had paid his Lordship 120,000*l.*, as previously agreed on. Permission was at the same time granted to have a motion heard for dissolving it before the Vice-Chancellor.

*Great Western Railway.*—This company has again been obliged to resort to a jury to assess the sum proper to be given as a compensation for a piece of land required for their line, and the result has afforded another instance of the just and liberal spirit which has actuated them in all cases. The land in question is about two acres, part of an orchard, situated at Hanwell, on which a Mrs. Knapp has a long lease. The original claim was for the large sum of 2,300*l.*, and during the progress of the trial, an offer of 750*l.* was made by the company. This was however refused, and after hearing the evidence of witnesses, and an address from Sir Wm. Follett, the jury (impanelled by the sheriff of Middlesex in Red Lion-square) gave a verdict of 600*l.* On Wednesday the cuttings were commenced on the extension line between Acton and Paddington.—*Monmouth Merlin*. [We cordially abominate these extravagant demands on companies.]—ED.

*Gosport and Fareham Railway.*—This railway branches from the projected Portsmouth and Southampton Junction Railway in the town of Fareham. It keeps within a very short distance of the western side of the Fareham and Gosport turnpike road, and terminates at Bingham Town. The length of this branch is about five miles, and the country is so favourable, that scarcely any excavation will be necessary, and the ascent nearly throughout will be only about five feet per mile.

*The Hampshire and Wiltshire Railway.*—This proposed line extends 22 miles. "The branches from the Southampton and London Railway in the northern part of North Stoneham parish, crosses the London turnpike-road at Chandler's Ford, skirts the parishes of North Baddesby and Hursby, passes over the Andover Canal, near the town of Romsey, whence, taking the direction of the river Test and the Southampton and Salisbury Canal, it passes within a short distance of Lockerley church and the village of West Dean, and proceeds by Peter's finger turnpike-gate, through Milford, to the city of Salisbury. The greatest ascent in the whole line is for a short distance near Salisbury, where the gradient is 21 feet a mile, but for a greater portion of the distance the elevation does not exceed 12 feet a mile. The cuttings are but of trifling extent, the deepest is 43 feet, about midway between the two extremities.—*Hampshire Chronicle.*

*The Central Kentish Railway.*—This company not having lodged the plans and sections agreeable to the standing orders, intends to appear in Parliament merely as a *competing line*.

*Kent Railway.*—The Committee of this company seem to be taking their measures very cautiously and quietly. They are determined to make no noise, but steadily to pursue their line quite through Parliament, in order to deposit their passengers and the Government despatches as quickly as possible at Ramsgate.

*Manchester, Cheshire, and Staffordshire Railway.*—This line is intended to take a much more direct course from Manchester to the capital than that by the lines of the Grand Junction and Birmingham Railways. We hear that no less than 32 miles will be saved in distance, and some objectionable gradients avoided; the worst are said to be on the Birmingham part, which are 16 feet per mile. These are important considerations.

*Manchester Connexion Railway,* for which application to Parliament for a Bill is to be made, unites some fifteen or more different lines of railway.

*Manchester and Sheffield Railway.*—*Carriage between Sheffield and Manchester.*—The carriers between these towns have given notice to the merchants and manufacturers of Sheffield, of a very considerable advance, viz., from 5s. to 10s. per ton in the carriage of goods, to take place immediately. This advance will increase the price of carriage of some goods to 40s. per ton. We understand that the Sheffield and Manchester Railway Company con-

template the conveyance of goods and general merchandise, at from 20s. to 25s. per ton; and steel at about 16s. It will scarcely be necessary, we think, after having stated these facts, to point out to the merchants and manufacturers of Sheffield the urgent necessity of forwarding, by every means in their power, this great undertaking.—*Doncaster Gazette*.

*Patriotism*.—Lord Lichfield, upon hearing the intention of making a railroad to Lichfield and Tamworth, passing through the county from north to south, declared that, though he would rather not, yet if the public benefit required, and no other way could be found, they might carry it through his dining-room at Shugborough, he should not oppose it. This we denominate genuine patriotism.—*Staffordshire Examiner*. [And so do we.] *Ed.*

*Railway Shares*.—The revising barrister for South Durham has decided that the shareholders of a railway, having an annual 40s. interest in the undertaking, are entitled to be registered as voters for the county. Now this is a sensible man, he construes law with equity.

*Shareholding*.—It is erroneously believed, that by registering shares, the holders thereof subject themselves to some responsibility, from which they were before free, the consequence of which belief is, that ignorant and timid people are induced to sell their shares at a sacrifice rather than incur the dreaded responsibility. Now the fact is, that registration is a measure of safety instead of danger to the shareholder, which assures him that his Scrip certificates are genuine, that he has a legal hold on the assets of the company, is entitled to vote in the arrangement of its affairs. In fact, it is a mere *record* of who is interested in the company.—*Mining Journal*.

*Southampton Railroads*.—It has been necessary in the course of constructing this work, to make some trifling deviations in this line, and also in the course of the roads in its immediate neighbourhood. The only alteration of any great extent is the one to avoid the tunnel at Popham Beacon. This is effected by leaving the original line in the parish of Weston Colley, and passing by the buildings belonging to Warren Farm, skirting the parishes of Steventon and Ashe, through East Oakley, and rejoins the present line in the parish of Wootton St. Lawrence. The improvement is effected by eight miles of new line, with an inclination of 1 in 250.—*Hampshire Chronicle*.

## FOREIGN RAILWAYS.

*American Railways*.—*Successive Railroads*.—The rapidity with which railroads are conceived and executed in this country is truly astonishing. But little more than a year was consumed in constructing the Utica and Schenectady Railroad, and scarcely is it finished, when we hear of two more, nearly as long, actually

undertaken from different directions terminating at the same point. We allude to the Utica and Syracuse, and the Utica and Oswego Railroads, the stock for both of which has all been taken up, and the works are going on with all possible despatch. There are also two other railroads for which charters have been obtained, terminating at Utica, which will probably be constructed; the Utica and Susquehanna Railroad, connecting Utica with the New York and Erie Railroad, and the Utica, Selkirk, and Watertown Railroads, opening the communication from Utica to the rich country on the Black, Salmon, and St. Lawrence rivers, and forming the most direct route to Lake Ontario at Selkirk Harbour. These two, if constructed, together with the one now in operation, and the two soon to be opened, will make five railroads, neither of them less than sixty miles long, and most of them considerably more, all terminating at Utica, and giving that city facilities for communication with all quarters of the country not possessed by any other inland town. If, in addition to these advantages, the proposed ship canal from Lake Ontario to Utica should be constructed—and the natural facilities for it are so great that it would seem very short-sighted to neglect them—the city of Utica would certainly occupy a very commanding position for commercial purposes. Let not any one say that these projects are chimerical, or beyond the reach of the enterprise of our people; for who, a few years ago, would have ventured to predict, that we could now, as we actually can, leave this city after tea, and take an early dinner next day in Utica?—*New York Commercial Advertiser*.

*Railroad across the Isthmus of Panama.*—The Company of Shareholders, at the head of which is Mr. Beddle, a United States man, and M. Azuero, a Columbian, having lodged the necessary securities, and perfected their guarantees with the Government of New Grenada for the making of a railroad, as conceded to them by a decree of the 6th of June last, and rendering navigable a stream which goes the remainder of the way across the isthmus, which separates the Atlantic and Pacific Oceans. The grant was finally perfected on the 26th of August, and the works are to be commenced without delay.—*Columbian Paper*.

*Railroads in Russia.*—The *Petersburgh Journal* gives an interesting account of the first trials of the steam-engines in the iron railroad on the 22d November, at which the Emperor and Empress, and all the members of the Imperial Family, were present.—*Morning Herald*.

A railway has been projected between Leghorn and Florence, the yearly number of travellers being more than 300,000.—*True Sun*, Dec. 3.

# PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on											
					Nov.		December.									
					29.	2.	6.	9.	13.	16.	20.	23.	27.			
9,500	.....	(3) Birmingham and Derby .....	£.	5	.....	.....	6	.....	8	8	7½	7½	7			
7,500	.....	(3) Birmingham and Gloucester .....	.....	10	1½	2	2½	3	.....	9½	9½	.....	8½			
15,000	.....	(3) Birmingham, Bristol, and Thames Junction .....	20													
660	.....	(3) Bristol and Exeter .....	100	5	.....	.....	.....	.....	3	.....	.....	.....	3½			
350	.....	Calcutta and Saugur .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....			
7,500	.....	Cheltenham .....	100		.....	.....	.....	.....	.....	.....	.....	.....	.....			
14,000	.....	(3) Cheltenham and Great Western .....	100	7½	.....	.....	.....	.....	5½	.....	.....	.....	.....			
2,000	.....	(4) Cheltenham, Oxford, and Tring .....	100	5	.....	.....	.....	.....	3½	3½	.....	.....	.....			
12,000	.....	(2) Clarence .....	100	100	.....	.....	.....	.....	.....	.....	.....	.....	.....			
8,000	.....	(3) Commercial Blackwall .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....			
7,500	.....	(4) Dublin and Kilkenny .....	100	2½	.....	.....	.....	.....	2	.....	2½	2½	2½			
60,000	.....	(4) Durham South-West Junction .....	20	3	.....	.....	.....	.....	.....	.....	.....	.....	.....			
	.....	(3) Eastern Counties .....	25	2	.....	.....	.....	.....	2	2	2	1½	1½			
	.....	Edinburgh and Dunbar .....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....			
5,000	.....	(3) Edinburgh, Leith, and Newhaven .....	20	1	.....	.....	.....	.....	.....	.....	.....	.....	.....			
13,000	.....	(4) Edinburgh and Glasgow .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....			
800	.....	(3) Durham Junction .....	100	10	.....	.....	.....	.....	.....	.....	.....	.....	.....			



# PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on											
					Nov.	December										
					29.	2.	6.	9.	13.	16.	20.	23.	27.			
			£.	£.	2	.....	.....	.....	.....	3	.....	.....	.....			
		(3) Midland Counties .....	50	5	2	.....	.....	.....	.....	.....	.....	.....	.....			
		(3) North Midland .....	.....	10	11	12 $\frac{1}{4}$	12 $\frac{1}{2}$	14 $\frac{1}{2}$	16	15	14 $\frac{1}{2}$	14	.....			
		(3) Northern and Eastern .....	100	6	.....	.....	.....	.....	3 $\frac{1}{2}$	.....	.....	.....	.....			
2,500	.....	(2) Preston and Wigan .....	.....	20	.....	.....	.....	.....	.....	.....	.....	.....	.....			
2,600	.....	(2) Preston and Wyre .....	50	18	.....	.....	.....	.....	.....	.....	.....	.....	.....			
4,000	.....	(3) Sheffield and Rotherham .....	25	6	.....	.....	.....	.....	.....	.....	.....	.....	.....			
1,000	6d. per c.	(1) Stockton and Darlington .....	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....			
1,500	.....	(2) Stanhope and Tyne .....	100	100	.....	.....	.....	.....	.....	.....	.....	.....	.....			
3,000	.....	(4) South Durham .....	50	2 $\frac{1}{2}$	.....	.....	.....	.....	.....	.....	.....	.....	.....			
28,000	.....	(3) South-Eastern and Dover .....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....			
24,000	.....	(4) Do. Brighton, Lewes, and Newhaven .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....			
	.....	(4) South Midland .....	50	1	.....	.....	.....	.....	.....	.....	.....	.....	.....			
40,000	.....	(4) South-Western (Stevenson's) .....	50	1	.....	.....	.....	.....	.....	.....	.....	.....	.....			
9,000	.....	(3) Thames Haven .....	50	2 $\frac{1}{2}$	.....	.....	.....	.....	.....	.....	.....	.....	.....			
6,600	.....	(4) Victoria .....	25	1	.....	.....	.....	.....	.....	.....	.....	.....	.....			
6,000	.....	(3) York and North Midland .....	50	3	.....	.....	.....	.....	.....	.....	.....	.....	.....			

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of  $\frac{1}{4}$  in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

THE  
RAILWAY MAGAZINE;

AND  
Annals of Science.

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No. XII.

FEBRUARY, 1837.

NEW SERIES.

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*On the Commercial Laying out of Lines of Railway.*

BY THE EDITOR.

IN the second and tenth numbers of the Railway Magazine, I have gone at some length into the principles of laying out lines of railway. Though I there occasionally made excursions into other matters, yet the grand points discussed were entirely of an engineering character. There is, however, another subject to be considered—the commercial—which, if not standing the most conspicuously forward, is, nevertheless, one of the most important.

We have taken it for granted that a line of railway is determined on, and on this ground have laid down our premises, and drawn our conclusions. Anterior, however, to all, comes these two plain questions—

1st. *Is a railway between two given places needful?*

2d. *If constructed will it pay?*

The answer to the first question necessarily carries with it an answer to the farther question, “Whether the line will be beneficial or not?” For if it be needful, it must, no doubt, be beneficial. We may, therefore, strictly confine ourselves to the simple question, *whether it be needful*. Now a new mode of transit can be needful only, when it renders the time and expense of transit less. It is not sufficient that it diminishes one; it must diminish both. There are many to whom a diminution of expense—as, for instance, to professional men—would not be an object, but a saving of time would. There are others again, whose circumstances oblige them to regard the pence, and not the hours; to these a reduction of the expense is the grand desideratum. To be generally beneficial, and consequently to be generally desirable, both time and expense of transit must therefore be contracted.

Let us suppose this can be done, another question then

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arises as to the quantum; for it is quite clear if it be a mere trifle, that the injuries inflicted by the invasion of privacy, cutting up of property, &c., will exceed the public benefit conferred, in which case the railway cannot be needful, and ought not to be allowed. In a letter I addressed to the Duke of Wellington in our sixth number, p. 223, I suggested—

*That no Bill ought to be permitted to pass, unless it could be clearly shown that the transit could be made in half the time now occupied by the road; and, that the expense of transit, in any case, should not exceed two-thirds of the present expense.*

Was this principle acted on in the Legislature, it would sweep off many of the projects now about to be brought before it; and particularly if the other condition mentioned in the same letter was added, namely—

*That the probable profits to the shareholders shall not be less than 10 per cent per annum.*

If two such cases as these could be fairly established in a line, there certainly could be no objection to granting a Bill. Nay, in the case of profit, if it could be clearly proved that the existing traffic would grant five per cent. over and above all expenses, the probability is, that a line of railway would pay well. For experience has settled it beyond a doubt, that a reduction of expense and time in travelling, very much increases the amount of it, though it does not yet appear in what proportion. In estimating, however, the traffic, those tricks and frauds which are so often practised on the Legislature, ought to be carefully watched. What right have men to take credit for goods which they know they can never have? Passengers, light goods, perishable articles, and such as require despatch and certainty in delivery, are the proper food of railways; but in weighty articles, not requiring to be speedily delivered, water carriage will probably ever keep the lead. Indeed, from the experiments lately made of the economy in more rapid motions on canals, some think they may ere long contend successfully with railways in the carriage of articles now considered the peculiar property of the latter; but this probably is more the result of sanguine temperament, than of sound reason. Nevertheless, it is quite certain that to take credit so largely, as is now done, for goods sent by water, is sheer delusion, and far beyond what the results can ever justify.

Deception is also practised to a very considerable extent in some cases in the estimate of the traffic by land. And

this is accomplished by so many little manœuvres, that it would be difficult to enumerate them. On all these accounts it is by no means easy to get at a true state of the facts. Possibly, however, if twenty or twenty-five per cent. was deducted for those intangible exaggerations, it would reduce the statements much nearer the truth; though it must be confessed that there are some who do the thing so cleverly, and maintain their positions with such mendacious gracefulness, that if ninety-nine per cent. was deducted from their statements, the question is, whether the remainder would not still be fifty per cent. too much.

Having settled the point respecting the expected revenue, we may in a general way ascertain the prospect as to pay of the proposed project; that is, we may answer the second question—the only one the generality of the shareholders care about—namely, “*If constructed, will it pay?*”

By calculations I have made from some of the earlier and the two last of the Liverpool and Manchester Railway Reports, it appears, that the disbursements for coach, carrying, coal, cartage, coach-office, engineering, locomotive power, maintenance of way, office, police, petty expenses, rent, repairs to walls and fences, stationary engine, tunnel, and waggon, amount to as nearly as possible, one-half of the gross receipts, leaving the other half to pay interest of capital, rates and taxes, profit, &c. And since this is the result of several years' experience on the largest in regard to traffic, and most successful line of railway yet made, we may take it as a fair experimental criterion for any other. It is, indeed, perhaps the very best we can have.

Assuming, therefore, one-half of the gross returns for the unavoidable expenses of the line, the question of profit is answered at once by the per centage which the remaining half bears on the estimated capital.

If, with the existing traffic, the residue will pay five per cent., that is the interest of the capital, we may, I think, very reasonably conclude that the line will before long return a profit of ten per cent., after taking in the increase of traffic, which a cheaper and more rapid means of transit will induce. It would, therefore, perhaps not be at all exaggerating, if the promoters took credit in such a case for a profit of ten per cent.

I have not here considered the extra capital, amounting to one-third of the whole, which is usually granted in railway Acts, because, in all probability, the improvements now making, and expected to be made, in locomotive engines

and the general construction of railways, will effect such a reduction in the annual expenses as will be sufficient to meet the extra interest when called for. Neither have I here taken into account the different costs of working different lines, owing to their better or worse construction. Correctly speaking, all circumstances of this kind ought to be considered; but, in general observations, like the present, it is impossible to descend to minutiae; and after all, it is doubtful whether the difference, unless the line was excessively bad, would make so serious an item as to negative altogether the question of utility of the railway.

Hence then, viewed as a public benefit and a profitable speculation to the shareholders conjointly, the question resolves itself into the two following; that is,

1st. *Whether the time of transit will be one-half that of the swiftest conveyance.*

2d. *Whether, including such parts of the traffic at present existing as the railway may fairly and reasonably expect to carry throughout the entire line and parts of it, one-third of the gross annual revenue will pay five per cent. on the entire cost of construction.*

If these conditions are fulfilled the public will have the advantage of a transit in half the time and at two-thirds the expense, while the returns on the existing traffic will be five per cent., and from the facilities and economy afforded to the public will, in all probability become at least ten per cent.

Would our Legislature see these two points satisfactorily established in the first instance, it would settle the question as to the public utility and private advantage of the line. They may afterwards go into other details with whatever minuteness they please; but the two inquiries mentioned may be considered to be the Alpha of the subject.

To prevent misconception, I must here beg more distinctly to state, that the returns of traffic are the actual charges at present made, supposing the conveyances are running at moderately remunerating prices, and are not running in opposition at ruinously low terms.

Many of our prospectuses are calculated at what are called railway fares. This is by no means so clear and satisfactory; but still if they are honestly set at two-thirds the present charges, it will amount to the same thing, only we must, instead of one-third of the existing traffic so computed, take one-half.

*Branch Lines.*

ONE of the greatest errors that companies forming grand trunk lines commit, is that of grasping at the making of branches. In general this arises from the rapacity of one or two influential parties in the company. Though these branches might pay of themselves by being brought under a thrifty and economical management, and having as many trains only as they require, yet when coupled with main lines, and conducted on the same large scale, with communications four or five times oftener than needed, the chances are fifty to one against them. It is like carrying on a huckster's shop with princely magnificence in a neighbourhood where there is but little to support it; or like uniting in co-partnership a little with a great man; the former may generally calculate on being benefited, but the chances are not so with the latter.

Trunk lines should give every encouragement they can to the formation of branch lines, but should not make them part and parcel of themselves. By this means they will become so many tributary streams of profit to the main lines in the shape of tolls or revenue, whether they themselves pay or not. It would also be prudent in the main lines to make the tolls, if tolls are paid, or the terms of junction, as easy to the branches as possible.

Besides, it is most impolitic and generally very irritating, in large companies, to sweep every thing within their own vortex. If there is anything to be got in the construction and management of branch lines, let the parties in the immediate neighbourhood, who will chiefly contribute hereafter to their support, have it. By this means they are made friends to the larger concern, and they will feel their interest identified with it.

I am induced to make these observations, in consequence of what I have personally observed in two or three companies, and I shall be glad if they will have the desired effect. I must here, however, guard myself against being understood, to include, under the head of branch lines, such uniting lines as would and are entitled to become main lines of themselves. These are by no means intended to be included; such only I mean as might be made a short distance to unite with a main line if there be one, but would never be carried out to any great length.—ED.

*On Ventilating and Lighting Tunnels, particularly in reference to the one on the Leeds and Selby Railway.*

By J. WALKER, Esq., F.R.S.L. and E.; President Inst. C. E.\*

THE want of ventilation and light seems the greatest objection to tunnels on railways and canals. An attempt is making to remedy both these evils in the tunnel now (1832) forming on the Leeds and Selby Railway, near Leeds, by a plan which is simple, not attended with much expense, and likely to be at least partially successful. A short description will suffice to make it understood.

The tunnel is nearly half a mile long; the greatest depth from the surface about eighty feet. As three shafts were required for raising the excavation during the progress of the work, it occurred to me, that by placing them at nearly equal distances, and walling them in a permanent manner, they might be left open to the surface afterwards. A strong elliptical casting, about eight feet long and five feet wide, has, therefore, been built in the arch of the tunnel, and over this a circular shaft or well, ten feet diameter, raised in strong brickwork. If it be found expedient to cover the well as a protection from the rain, it may be done with glass, raised on columns of such height as to admit a free circulation of air between the surface of the ground and the roof.

So much for ventilation. But as the light afforded by the shafts is confined to the space immediately below them, the desideratum is to throw it along the tunnel, and I think this may be done so as to give a useful light by means of plane reflectors of tinned iron placed on the ground between the two lines of railway, at such an angle as to reflect the light where it will be most useful. The idea was suggested by the rum vaults in the West India Docks, where the marks on the casks are ascertained by catching the faint light from the windows upon a small piece of tin plate, and throwing it on the casks. Those who have seen this done have generally been surprised at the useful effect produced; but in the case of the tunnel, the light coming directly down the shaft is more powerful, and the effect of the experiment I have made has much exceeded my expectations. I shall take care that the results of any future observations be communicated to the Institution.

\* From the Transactions of the Institution of Civil Engineers.

P.S. In compliance with the promise given in the preceding paper, I have procured from Mr. George Smith, the resident engineer on the Leeds and Selby Railway, the annexed observations on the subject containing the result of his recent experience. Though they do not in all respects realize the expectations I had formed from the first experiments which were made before the tunnel was completed, or the railway formed, I may remark, that while the shafts seem to be very serviceable for ventilation, the light they supply is useful to those whose duties require them to pass through the tunnel on foot or unaccompanied with an engine. Mr. Smith's remarks are dated Dec. 1835, and are as follows :—

“At the present period, when there are so many railways in progress and in contemplation, many of them with tunnels of considerable length, the following observations on the effects of the locomotive engines, working in the tunnel of the Leeds and Selby Railway, may be interesting to those who have not the opportunity of witnessing those effects daily and under all circumstances.

“The tunnel of the Leeds and Selby Railway is nearly half a mile in length, situated at the commencement of that railway at the Leeds end, and has a slight ascending inclination in going from Leeds. The situation and inclination cause a considerable difference in the quantity of steam discharged from the chimneys of two engines travelling in opposite directions.

“The ascending engine labouring at a first start against the inclination, to get into speed, (which is scarcely done before leaving the tunnel,) causes a great expenditure of steam, &c., while an engine, coming in the opposite direction, having a clear fire, and every means taken to prevent the generation of steam, by opening the fire door and pumping water into the boiler, expends very little, and that through the safety valve, the smoke from the chimney not being perceptible. It will, therefore, be necessary to detail the effect of an engine passing through the tunnel from the Leeds end only.

“The fires of the engines are made up, previous to starting, with coke mixed with coal, to hasten the ignition of the former; the smoke from the coal is of course mixed with that of the coke and steam, adding to the density of what escapes from the chimney, and continues to do so for some time, frequently through the whole length of the tunnel: but notwithstanding this, the tunnel is generally

clear in less than five minutes after, in many cases nearly as soon as the engine has left it. This of course is governed, in a great measure, by the force and direction of the wind. In foggy weather, there being little or no wind, the smoke from the coal is left after the steam is condensed, and forms itself into a cloud which sails slowly along the roof, travelling at the rate of from two to three miles per hour; a great part of it ascends the shafts, but from the heavy state of the atmosphere a considerable portion passes them and discharges itself at one end of the tunnel. It should here be mentioned, that the entrances into the shaft from the tunnel, are much contracted, having not more than five feet in the longitudinal, and eight feet in the transverse direction of the tunnel, and much of the smoke, &c., passes on each side of the shafts; and in consequence of the sluggishness of the draught on those days, the lower part of the cloud has not sufficient time to alter its course up the shafts.\*

“Two engines, having coal mixed with the coke in their fire boxes, left the Leeds depôt during a very heavy morning, and followed each other quickly through the tunnel; each left a cloud behind, the one keeping at a considerable distance from the other. The smoke (the steam appearing to have been condensed) seemed to have lost its usual sulphureous smell, and resembled a dense fog, the denseness appearing greater from the darkness of the tunnel; and such is the freedom of those clouds from anything unpleasant, that passengers in close carriages are not aware of having passed through them, which they do almost instantaneously.

“Passengers are never annoyed with the steam, &c., from the chimneys of the engines, as it does not descend low enough, except on heavy days, and even then, the progress of the engines carries them forward before it is so low as to affect them.

“From the effects described above, it appears evident, that in tunnels, situated only a short distance from the starting-place, it is extremely probable little or no inconvenience will be felt by the passengers passing through them.

“Previous to the opening of the Leeds and Selby Railway, great doubts were entertained by many, and among others a

\* This naturally suggests the propriety of having the shafts much larger, probably the same diameter as the width of the tunnel.

celebrated lecturer, as to the fitness of the atmosphere for respiration, in a tunnel worked by locomotive engines: now that the incorrectness of that idea is fully proved, as far as regards a tunnel half a mile long, those doubts are still entertained by many individuals as to tunnel of much greater lengths. These doubts will, probably, prove as groundless as the former ones, for the following reasons:—

“A considerable quantity of the steam from the engines ascends the shafts at all times; but there is no doubt a large portion is also condensed in the tunnel; and were there no shafts at all the steam could not remain long uncondensed, surrounded, as it will ever be, by walls always at an even temperature, a short distance from the ends of the tunnel, saturated with moisture, and the surface, in many parts, covered with water.

“The coke, particularly when in a high state of combustion, gives out little smoke, and, from its having passed through the steam, loses, like the coal, the greater part, if not all its offensiveness, and mixing with the air that has been used for combustion will, from its buoyancy, readily find its way along the top of the tunnel to the first shaft, and make its escape up it.

“Two great inconveniences in tunnels are, noise and want of light; the former it will be difficult to remedy, the latter may be easily so, by carrying oil, or portable gas lamps with the carriages. Oil lamps are used with the evening trains, during the winter months, on the Leeds and Selby Railway, and give sufficient light in their passage through the tunnel. Some experiments were made with tin reflectors at the bottom of the shafts, and although the light reflected was sufficient to read the larger print in a newspaper advertisement at all parts of the tunnel, (there being three shafts) it is very doubtful whether lighting tunnels by reflection will be of use for passengers. The rays of light are thrown on the walls so very obliquely, that from the rough and dirty state of their surface, few are again reflected from them, and these are too feeble for the eye to accommodate itself to so great a transition during the time a train would be passing through a tunnel of moderate length.

“A passenger sitting in a close carriage, having only the walls to look at, would, under such circumstances, fancy himself in total darkness, although the tunnel generally might be moderately light. The difficulty of keeping reflectors clean from the effects of damp, steam, &c.,



would be a considerable expense in a long tunnel; and it must also be born in mind, that the moment an engine has passed a reflector it becomes of no use to the train attached to that engine, as it is immediately surrounded with steam, &c., forcing its way up the shaft, and the next reflector, in a long tunnel, would probably be a quarter of a mile from the one thus thrown into darkness."

[We insert the above paper in our Magazine with pleasure, as conveying a fair experimental proof of our views in No. II., respecting the impossibility of usefully lighting tunnels for trains. Much credit is due to Mr. Walker for the candour with which he has brought forward experiments, showing the want of success in the method he proposed. Many would have endeavoured to stifle them, or at least to smear them over in such a manner as to hide their real import. Mr. W., however, has taken the course every man would, who is above little things, and wishes to advance truth. We have no doubt the paper will be read with interest at this time, especially by all who discountenance tunneling. Neither will they fail to see in Mr. Smith's narrative the equal difficulty in ventilating them, nor the noise, &c., to which they are subject. In fact, Mr. Smith's account very nicely echoes the opinion as to their various nuisances, uttered by us in our aforesaid second number.—Ed.]

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### *Lecture on Railroads.*

[Continued from p. 60.]

HAVING enumerated the objections that have been urged against the formation of railroads, it is only fair to listen to the arguments that may be employed for their adoption. It is by considering their comparative value that a correct judgment can be formed on the subject. It is, therefore, by their moral and political influence that we are to form our decision, not merely of the present, but also on the future interests of our country. The importance of the former will be admitted by the friend of religion; and the latter will not be viewed with indifference by the true patriot. Neither, therefore, will be unnoticed. The first consequence we shall mention, resulting from the establishment of railroads, will be the saving of time. This is a fact that admits of no question. Its

application will be felt by every one, who admits his responsibility for the talents he possesses, as well as for the opportunity afforded for their improvement. It is not on theory we depend for the assertion we have advanced. Upon facts we rest; upon experiments made and well established. The Manchester and Liverpool, the Darlington and Deptford, have furnished to thousands of thousands proof of the velocity that can be attained by travellers on railroads. It may, however, be proper to refer to well-known authorities; and Dr. Lardner's work on railroads may be quoted; at the same time it may be observed, that since that publication many important improvements have been made in the formation of railroads, and in the construction of the engines which pass upon them." The following is Dr. Lardner's declaration:—"I placed a cargo of thirty-six persons on an engine, with which I succeeded in acquiring a velocity of forty-eight miles in an hour. He believed a still greater velocity might be attained." This hath subsequently been effected. But, not to dwell on extremes, the evidence adduced before the Committees of both Houses of Parliament would show, that, on the average, engines would go at the rate of twenty miles per hour. How immense the saving of time thus secured. How vast its importance in cases of emergency. Suppose the procuring of medical aid in extreme danger, or the necessity of receiving information of the sailing of a ship, or the arrival of one. Suppose a friend unexpectedly called to a distant clime, and another anxious to take leave of him. Your own mind will multiply instances in which rapidity of communication would be deemed of incalculable value. Be it remembered, that to velocity of motion, ease and security are united. These will contribute to destroy the effect of distance, and appear to bring remote places nearer to each other. But another advantage must be mentioned, the quickness with which heavy burthens are conveyed from place to place. A reference must again be made to Dr. Lardner's work. He says a steam-engine is capable of drawing 90 tons weight, at the rate of 20 miles an hour. Admitting this, you can transfer that weight between Manchester and Liverpool, the distance being 31 miles, in little more than 3 hours. See the contrast, if the same weight were to be conveyed by horses on the highway. It would require not less than 270 horses, and would not be accomplished in less than one day, allowing it even of 9 hours' length. This fact alone deserves consideration.

For instance, a cargo may require to be unloaded from a vessel, it may have been purchased by a merchant at Manchester, 180 tons (or twice 90), may be delivered in 6 hours; but if carried by land, it would be necessary to consume 18 hours, and employ 810 horses. The diminishing the numbers of horses is a subject of national importance, both as to capital fixt, and provision consumed. Neither of them are topics on which it is our intention long to insist, but which are immediately involved in the subject we are investigating. Lessening the demand for horses, will increase the opportunity of acquiring support for the human race. The land now devoted to the growth of hay or oats, will be converted to the feeding of cattle or the production of grain. The effect will be an increased demand for agricultural labour, and a diminution of the price of produce. We shall lessen our dependence on foreign supplies of corn, and, by augmenting our internal resources, furnish means for supporting an increase of population. By this means the false alarms occasioned by Mr. Malthus's essay will be removed, and the question of corn-laws set at rest. This is not an imaginary picture; though it is admitted that time and experience must test its validity. There is, however, no difficulty in proving that the increased production of land will add to its value. A fresh direction will be given to capital. A new motive afforded for its application to the cultivation of the soil, by an easy transit being furnished to distant markets. Hence will poultry and vegetables be reared, where, because of the want of consumers, they are now neglected; and towns obtain a supply of provisions at reduced prices, in consequence of the competition that will exist among the venders. Nor will these be the only results of the general adoption of railroads; a greater equality will be produced in the rent of land and houses than now obtains, and also in the price of manufactured goods. Two other articles claim particular attention, the lessening the danger of a supply of coals in places remote from collieries, an evil peculiarly felt when the rivers and canals are frozen, and the stock on hand inadequate to the demand. By the same means an opportunity will be afforded for introducing manufactures where they are now wanted.

To these statements may be added the effect on the encouragement of our fisheries, which are the nurseries of our seamen. The losses sustained by inability to contend with wind and waves, and to reach a market before the fish

are unfit for consumption, are well known; and, from the same cause, the injury to the health of the poor, who purchase, at a cheap rate, food that should have been consigned to the dunghill. But these circumstances are too well known to require enlargement. One argument more shall be mentioned, particularly adapted to the audience I have the honour to address; the improvement of science. This hath already been accomplished, in various instances. The engines have been rendered lighter and safer; new plans have been introduced for lessening friction, and giving stability to the rails; the quantity of coal consumed has been diminished; the annoyance of smoke removed; the danger of the bursting of boilers obviated; and that substance which occasioned adhesion before, is now converted to beneficial purposes. Chemistry has been employed in analyzing coals, and showing their peculiar properties, and ascertaining the comparative strength of coke and coal. A stimulus is thus afforded for new investigations, and for generalizing benefits that formerly had a local habitation. The result will be, what a modern author has predicted, provincial dialects will cease, and our language acquire a perspicuity and consistency it now wants. In another place, he observes, if we were to study the origin of local terms, and trace the source of peculiar customs, we might facilitate the attainments of correct views of past events. Railroads will present incitements to such investigations; and, by facilitating intercourse, advance civilization with its attendant blessings. In the words of the celebrated Cuvier I will conclude. "We are only in the very infancy of knowledge." If we were inspired with the ardour that philosopher possessed, if we would only strive to imitate the noble example he furnished, if we would, like him, lay aside prejudice, and remember the debt we owe to our Creator, we should then feel our obligations to do all the good in our power to our brethren. We should strive to diffuse knowledge, based on Christian principles; and, like him, leave a legacy to posterity, that would contribute to promote peace on earth and good-will to all men. These are some of the effects philosophy imparts, and the religion of Jesus confers. May their pursuit and attainment ever dignify the conduct of the members of this, and all similar institutions!

*On the Influence of Artificial Rarefaction and Condensation  
in some Diseases.* BY A SUBSCRIBER.

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TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—I read with considerable interest your account in No. X., of Sir James Murray's valuable paper, "*On the Influence of the Artificial Rarefaction, or Diminution, of Atmospheric Pressure in some Diseases; and the Effects of its Condensation or increased Elasticity in others.*" With regard to the application of diminished pressure to the chest and other parts of the body, I would beg to put in a claim to priority of invention, in favour of a friend who is now absent; without at all, however, detracting from the merit of Sir James.

In 1831, Dr. John Dalziel, when practising in the neighbourhood of Dumfries, started the idea, and had an apparatus constructed for the purpose. It consisted of a large air-tight wooden vessel, containing a pair of bellows, and room for a person to sit in conveniently. The lid consisted of two parts, with a semi-circular notch in each, so as to embrace the neck of the patient. When the patient was to be operated on, he took his seat in the vessel, and, the lid being applied, he was wholly enclosed, excepting the head; and any aperture between the lid and the neck was made air-tight by means of dough. The nozzle of the bellows passed through the side of the vessel, and terminated in a valve opening outwards. The rarefaction might be produced either by the patient working the bellows himself, or by another person working them on the outside, by means of a rod passing through an air-tight collar in the lid. On inflating the bellows, air was taken into them from the vessel, and on compressing them it was expelled through the valve on the nozzle, which permitted its escape but prevented its return. Thus each stroke rarified the air in the interior of the vessel. I was one of a few who, from curiosity, tried its effects. The rarefaction was carried on gradually till the inspirations felt forcible, and the expirations became difficult, and required an effort to produce them. I was sensible of no other feeling, either pleasant or unpleasant, on any other part of the body. There was no feeling of a determination of blood to the skin; nor could the appearance of any be discerned, on examining the head through a glazed aperture in the side of the vessel.

When the cholera was prevalent here, the apparatus was sent to the Royal Infirmary, but I have not had an opportunity of hearing anything of it since.

I am, Sir, your most obedient servant,

A SUBSCRIBER.

*Edinburgh, Jan. 11, 1837.*

*Insurance Companies.* BY A FATHER.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—You and your correspondents having taken upon yourselves to advise the public on the investment of capital in companies formed for the construction of railways, with the laudable object of facilitating transit between different parts of the kingdom, induces me to think that you may not be indisposed to extend your attention to other joint-stock companies, and favour your readers with occasional suggestions on undertakings, the success of which is of equal importance to their proprietors, and to the public with that of railroads.

I allude more particularly to the numerous life assurance societies and joint-stock banks, which have started into existence, as it were, simultaneously with the companies to which you have more immediately directed your attention.

In railway companies the shareholders are the parties principally interested in the success of the schemes; whereas, the success of a life assurance company is of much more consequence to the assurers with it, than even to the proprietors of its shares; while the depositors of a banking business are much more interested in its success than the shareholders.

As, however, these kinds of companies are not sufficiently identified in their characters to admit of their being discussed together, I shall confine my present remarks to societies formed for the assurance of lives.

That such societies are of the utmost importance to the community there can be no doubt, and hence the necessity of bringing the nature of such institutions prominently before the public.

There are three descriptions of societies for the assurance of lives, denominated—

1. Mutual assurance societies, or such as are formed by a number of persons joining and agreeing to pay, annually or otherwise, certain sums according to their respective ages, to

secure at their deaths, for the benefit of their surviving representatives such a sum as those annual payments or premiums, as they are denominated, would amount to, improved at compound interest during their lives, supposing they extended to the average number of years which persons of their age when entering the society have been found to live.

2. Proprietary companies, or such as are formed by a number of persons subscribing a capital with which to commence the business of the society, and guaranteeing, on the receipt of a stipulated premium, during the life of a person to pay a fixed sum at his death, the proprietors taking upon themselves the whole risk, and appropriating to themselves all the profits which may accrue from the transaction.

3. Mixed companies, in some measure partaking of the nature of the other two combined, being formed by a proprietary of shareholders, who generally take upon themselves the management of the society's affairs, and divide between themselves and the parties assuring the profits of the company in certain stipulated proportions.

There are some societies which comprehend in their plans the means of changing from the third to the first class, by paying off, on certain conditions, the capital subscribed as a guarantee fund for the commencement of business, upon which they evidently become mutual assurance societies.

Besides these distinctions, there are many minor varieties in the plans of the different offices—especially in the premiums charged for the same amount assured—quite sufficient to puzzle a person like myself, who have an income arising entirely from my personal exertion, limited, but sufficient to spare a portion which I wish to appropriate, of course in the most advantageous manner, to secure a provision for my surviving family after my decease. Now my object in addressing you is, to obtain from yourself or some of your numerous correspondents, advice as to what kind of office I should apply. I would not have presumed to trouble you with this application, did I consider it an individual case, affecting myself only, but I believe it to be the case of thousands, and therefore presume your counsel to be of much public utility.

The following are a few of the questions which occur to my mind as bearing directly upon the subject.

1. Whether in the proprietary offices with a large subscribed capital the *assurers* do not suffer by having the whole or a considerable portion of profits, arising entirely from their

premiums, appropriated to the benefit of the shareholders.

2. Whether in mutual assurance offices with a subscribed capital there is not considerable risk of their instability, if heavy losses should occur before they are fully established with business sufficient to afford them a tolerable average on each class of assurers?

3. Whether the plans of returning to the assured in some of the old established mutual assurance offices are not objectionable, on the ground of their giving undue advantages to some classes of assurers over others?

4. Whether the low rates charged by some of the recently formed offices are founded on *real observations* of the duration of human life in this country, or whether they are sufficient, after providing for the expenses of the establishments and remunerating the shareholders for the use of their capital, to provide for the claim when the death occurs?

This is a most important question, as the instability of an insolvent office may not be discovered till after many premiums have been paid, which of course would be entirely sacrificed in changing the assurance to another office; besides, the health of the party may have so far changed as to render a new assurance impracticable.

If I were about to assure my life for the term of *one* year only, I should not hesitate a moment about going to that office which charges the very lowest rates; if for *two* or *three* years, I should make inquiries before I did so; but as I propose effecting an assurance for the whole term of life, I have adopted the plan of seeking for information through the medium of your Magazine.\*

I am, Sir, yours, &c.

A FATHER.

### *Railways to Brighton.†*

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—Having lately had my attention drawn to the lines of railway between London and Brighton, as deposited in

\* The questions put by our correspondent, are indeed of so much interest, and of such present and future importance to society, that we should be happy to see the matter thoroughly inquired into.—[Ed.]

† We have ourselves been occupied with calculations on the present Brighton lines; but as it was a professional occupation, we do not think ourselves at liberty to publish our computations, which are, of course, the property of others.



the bill-office during the last session of Parliament, I have been struck with the remarkable coincidence between them in one very important feature; namely, their respective *times of travelling*, particularly between the lines of Sir John Rennie, Mr. Stevenson, and Mr. Cundy. The Oxted line is altogether an exception; the time of travelling this line (up and down) being, according to my computation of it, fully one hour and a half more than the time which would be occupied in travelling (going and coming) by Mr. Stevenson's line, or 45 minutes more time on each trip. I am, therefore, inclined to think that neither the distances nor the gradients of the Oxted line have been given correctly. I shall therefore, omit it altogether in my present brief comparative view.

By Sir John Rennie's line the distance between London and Brighton is 49 miles and 68 chains; by Mr. Stevenson's, including that part of the Southampton line, by which he departs from and arrives in London, the distance is 54 miles and 64 chains; and by Mr. Cundy's 55 miles and 53 chains. Mr. Cundy's line being 60 chains longer than Mr. Stevenson's, and Mr. Stevenson's 4 miles and 76 chains longer than Sir John Rennie's.

The loads to be carried on these lines, I have assumed to be equal; but the powers of the engines employed to be, of course, proportional to the gradients,—the *maximum* gradients, in the respective lines, exclusive of inclined planes.

On the supposition that these roads are executed and in good working order, the following would be the *times* in which they would be travelled: the regulated speed being at the rate of 40 miles an hour, on level ground and descending inclinations.

## SIR JOHN RENNIE'S LINE.

	h.	m.	s.
34½ miles at 20 feet per mile of gradients, including the inclined plane between London and Croydon (going and coming)	2	44	0
15½ level, or very nearly so	0	45	30
3 stops of 3 minutes each = $9 \times 2 =$	0	18	0
Curves	0	15	0
Delay at the incline, very moderately stated at	0	2	0
	<hr/>		
	4	4	30
	<hr/>		
Each trip being	2	2	15
	<hr/>		

## MR. STEVENSON'S LINE.

	h.	m.	s.
28 miles and 46 chains at 16 feet per mile (going and returning)	2	15	0
23 miles, averaging 7 feet per mile, do.	1	28	8
2 miles and 61 chains, level do.	0	8	0
2 stops at 3 minutes each = $6 \times 2 =$	0	12	0
Curves	0	12	0
	<hr/>		
	4	15	8
	<hr/>		
Each trip occupying	2	7	34
	<hr/>		

## MR. CUNDY'S LINE.

3 miles and 71 chains, at 16 feet per mile (going and coming)	0	18	30
51 miles and 62 chains, averaging $9\frac{1}{2}$ feet per mile, do.	3	30	0
2 stops of 3 minutes each = $6 \times 2 =$	0	12	0
Curves	0	11	0
	<hr/>		
	4	11	30
	<hr/>		
Each trip occupying	2	5	45
	<hr/>		

## ABSTRACT.

	Going and coming.			Each Trip.		
	h.	m.	s.	h.	m.	s.
Rennie's	4	4	30	2	2	15
Stevenson's	4	15	8	2	7	34
Cundy's	4	11	30	2	5	45

By this it appears, that (if my calculations be correct, and I have endeavoured to exercise the utmost impartiality) each trip by Sir John Rennie's line of last session may be travelled, with an equal load, and an engine having a power corresponding to 20 feet per mile of rise, in 5 minutes and 19 seconds; and by Mr. Cundy's, which has no tunnels on it, in 1 minute and 49 seconds less time than by Mr. Stevenson's line.

These differences being so very trivial, it is obvious that other considerations than the mere *times of travelling* must

prevail in influencing the decision of Parliament in their preference of the line to be adopted between the metropolis and Brighton—unless a much greater discrepancy in that respect shall be shown to exist between the lines now deposited. But these I have not yet seen.

On referring to Dr. Lardner's evidence, I find that the Doctor has made the difference of time between Sir John Rennie's line and Mr. Stevenson's to be 18 minutes and 46 seconds in favour of the former; the difference between us therefore is, 13 minutes and 27 seconds. With great deference I am induced to think that the Doctor may have, perhaps, taken his *averages* too loosely. In a magazine, however, of the 9th of July last, I find that the tables have been completely turned, for there it is stated that Sir John Rennie's line would occupy 3 hours 36 minutes and 30 seconds, while Mr. Stevenson's would occupy only 3 hours and 29 minutes, making a difference of 7 minutes and 30 seconds *in favour of Mr. Stevenson's line*, instead of 18 minutes and 46 seconds *against it*, according to Dr. Lardner.

Right or wrong, my computation comes much nearer to the Doctor's than this.

WM. TAIT, C.E.

14, Grafton Street, Fitzroy Square.

### *Canals and Railroads in the United States.*

THE very interesting table on the next page, taken from the "Commercial List and Philadelphia Price Current of December 3, 1836," has been kindly sent us by some unknown friend. We are sorry to say it came to us in a very mutilated state, owing to the manner in which the paper was folded, but we have endeavoured to supply the defects as well as we could. There are, evidently, some errors in the arithmetic of the table, but as we have no means of discovering in which particular columns they lie, we have not attempted to correct them except in one or two obvious cases. It appears from this table that the average cost of railways in America is about 5,000*l.* per mile, a little less than 18,000*l.*, the average cost of ours.—ED.

To the Editor of the Commercial List.

Sir,—The following table, compiled principally from the American Almanack, and Repository of Useful Knowledge, for 1837, is believed to be essentially correct, and displays an extent of enterprise and capital, unequalled at any former period, by any country in the world. I send it for publication without offering any comment. It exhibits the gigantic resources of our country in a new and condensed form, and will prove interesting to all classes of the community, whether rich or poor.

A TRUE FRIEND TO INTERNAL IMPROVEMENT.

STATES.	No. of Canals.	CANALS.				RAILROADS.								Total Canals and Grand total of Canals and Railroads, made, making, &c.			
		Made		In progress		Made		In progress		Projected		Railroads making and projected.		Total Canals and Grand total of Canals and Railroads, made, making, &c.			
		Miles	Cost doll.	Miles	Cost doll.	Miles	Cost doll.	Miles	Cost doll.	Miles	Cost doll.	Miles	Cost doll.	Miles	Cost doll.	Miles	Cost doll.
Maine .....						1	200,000	15	300,000	416	3,663,500	416	3,663,500	426	3,663,500		
New Hampshire ..						4						15	800,000	15	800,000		
Vermont .....						4						400	4,000,000	400	4,000,000		
Massachusetts .....	4	99	1,528,000			16	4,401,454	205	6,150,000	183	3,920,000	388	10,070,000	604	15,999,454		
Rhode Island .....	2	27	490,000			2		40	1,200,000	10	300,000	50	1,600,000	77	1,990,000		
Connecticut .....						3		90	2,700,000			90	2,700,000	90	2,700,000		
New York .....	18	767	13,884,352	369	21,988,728*	93	3,500,000	1557	31,155,000	906	18,433,000	2832	71,576,728	3774	88,061,108		
New Jersey .....	3	172	5,560,000			7	2,960,000	87	1,705,000	75	1,500,000	162	3,205,000	442	11,725,000		
Pennsylvania .....	15	839	21,601,325	469	14,790,000	43	13,874,068	817	15,235,000	1178	22,085,000	2464	52,110,000	3754	87,565,000		
Delaware, 1 .....	1	134	2,200,000			4								134	2,200,000		
Maryland, 2 .....	2	10	200,000	341	10,230,000	4	4,306,507	274	6,850,000	1089	21,780,000	1704	38,860,000	1844	43,366,507		
Virginia .....	19	42	1,119,061	501	6,202,765	24	1,176,103	153	1,535,000	1260	12,595,000	1914	20,832,765	2058	22,638,929		
North Carolina .....	3	23	460,000			5				1008	15,120,000	1008	15,120,000	1031	15,580,000		
South Carolina, 3 ..						8	2,040,000	100	1,500,000	607	12,140,000	707	13,640,000	843	16,680,000		
Georgia .....	1	16	165,000	60	1,800,000	7		429	5,435,000	308	3,370,000	797	10,805,000	313	10,970,000		
Alabama .....	2			53	1,890,000	8		46	698,000	985	16,075,000	1084	18,655,000	1084	18,655,000		
Mississippi .....						4		178	1,320,000	51	765,000	229	2,085,000	229	2,085,000		
Louisiana .....						5		560	11,200,000	6	120,000	566	11,320,000	566	11,320,000		
Tennessee, 4 .....																	
Kentucky .....	3			560	12,800,000					56	660,305	676	14,660,305	706	15,580,305		
Ohio .....	17	405	7,546,000	575	9,145,342	3	920,000	60	1,200,000	2380	27,005,000	3244	40,889,342	3649	48,435,342		
Indiana .....	3			463	6,200,000			289	4,739,000	253	2,650,000	716	8,850,000	716	8,850,000		
Illinois, 5 .....	1			95	7,000,000					1760	17,250,000	1855	24,250,000	1855	24,250,000		
Missouri .....										200	2,500,000	200	2,500,000	200	2,500,000		
District of Columbia	2	84															
Florida, 6 .....																	
Total .....	87	2,422	58,753,768	3,486	92,646,833	283	33,458,132	4,900	92,914,000	13,131	187,251,805	21,517	571,092,638	25,179	459,025,145		

1. The Railroad passing through this State, is included in Pennsylvania. 2. About 60 miles of the Chesapeake and Ohio Canal, are completed, being up to Harper's Ferry; and the proposed Railroad of 1069 miles, put down to this State, extends from Baltimore to New Orleans. 3. This includes the projected Railroad from Charleston to Cincinnati. 4. The Railroad from Nashville to New Orleans, going through this State, is included in Louisiana. 5. Illinois has a remarkably heavy rock excavation. 6. Florida has incorporated several Railroad Companies, but they are not sufficiently described to determine their magnitude. \* This sum includes enlarging the Erie Canal, now in progress.

Note. This table is, without doubt, much within bounds, as a number of Railroad Incorporations noticed in the Repository by name, I was unable to trace to full satisfaction on the maps, and have omitted them.

*Proposed Improvement in the Arrangement and Construction of such Railway Tunnels as are intended to be Worked by Locomotive Engines, for which His Majesty's Royal Patent has been obtained.* By HENRY BOOTH, Esq., Treasurer, &c. of the Liverpool and Manchester Railway.

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[The following communication will be read with great interest, as coming from a gentleman of well-known experience and sound judgment in all railway matters. If any thing can render tunnels tolerable, we are satisfied Mr. Booth's plan will. At all events, where they must be had, it will render them the least exceptionable possible.—ED.]

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THE difficulties of tunnels of the ordinary construction, worked by locomotive engines, are principally the following:—

The rails will generally be moist and dirty, and the *adhesion*, and, consequently, the efficiency of the engines will be thereby reduced, perhaps one-half. The wheels, even when *coupled*, will be very liable to slip; the evil of which is, not only the waste of steam and fuel, but during the unavoidable delay occasioned, the tunnel will be filling with steam and smoke.

In the ordinary working of a railway, it may be expected to happen, that when one engine is ready to enter the tunnel, another engine will emerge in the *opposite* direction, in which case the tunnel will be already charged with steam and smoke, in addition to what shall be caused by the engine about to pass through.

If two engines meet and pass in the tunnel, the noise will be like a continuous charge of musquetry, and the steam and smoke in proportion.

If a tube in the locomotive engine boiler should burst, or if a quarter of an hour's delay should take place, from the loss of a bolt or a cotter, there will be great confusion from the increased darkness of the tunnel under such circumstances, and the least possible evil that can arise will be, that all traffic, on *both lines*, shall be stopped till the tunnel be cleared: and, it must not be forgotten, that, owing to the slippery state of the rails, and to the darkness rendering it more difficult for the engine-man to inspect his machinery and ascertain the level of the water in his boiler; accidents and delays will be *more likely* to take place in the tunnel

than elsewhere, as well as be more inconvenient when they do take place.

The desideratum, therefore, has been to devise some plan, by means of which locomotive engines may work through tunnels with comparative safety, certainty, and expedition; and especially so to arrange matters, that if an engine, travelling in *one* direction, by any chance be stopped midway in the tunnel, filling it with a dense atmosphere, which the light of lamps will not penetrate, the engines travelling in the *opposite* direction, *at the same time*, need not be delayed or inconvenienced by the occurrence.

I propose to accomplish these objects by constructing duplicate tunnels with different gradients; that is to say, instead of *one tunnel* for engines passing in both directions (thereby, in the event of an accident, making the traffic on one line not merely participate, but increase the confusion arising from the other), I recommend two distinct and *separate* tunnels; namely, instead of one tunnel, 25 feet wide and the same height, I propose to construct two tunnels, each 15 to 16 feet wide, and 20 feet high; the cubical contents of excavation in each case being, in the aggregate, pretty nearly the same.

But the having two distinct tunnels accomplishes only about half the proposed improvements. The tunnels must *have different gradients*, so as to make the passage *in each direction* the easiest portion of the road, or of that section of the road where the tunnel occurs. If the railway has to pass through a summit ridge of hill, or table land, instead of letting it pass through, *on the level*, I propose to regulate the gradients so as to give each tunnel a *fall of not less than 10 or 12 feet per mile*; which, supposing the tunnel to be a *mile* long, would be accomplished by each tunnel being raised at one end and depressed at the other, five or six feet from the level line; each tunnel declining in the opposite direction: and if the stratum be rock, the two lines need not be many feet asunder. By this arrangement, of course, it is not proposed to gain any mechanical advantage; as many feet as you *move downwards*, you must (either previously or subsequently) *move upwards*: but the advantage is that you choose your ground; and it being doubly important that no delay should take place in the tunnel, and from the state of the rails, &c. &c., the greatest difficulties presenting themselves at that spot, I arrange that only half the resistance or difficulty shall be met with in the tunnel as on the open railway. The chances, therefore, are, that if

an engine, from being out of order, fail on the journey, *it will not fail in the tunnel*. And in the event of a rare instance of impediment in the tunnel, still, only one line will be incommoded; the other line in the opposite direction, will be clear of smoke, and free from interruption; and, above all, will not add to the risk of passengers being injured, which, in the confusion of an accident, and in the darkness of a tunnel, might, unfortunately, be found to be the case, from their spreading themselves inconsiderately over both lines of way.

In order to this arrangement, an additional quantity of land may probably be necessary for some distance, at each end of the tunnels; one line being raised and the other depressed, each in comparison with the other, whatever the gradients may be; but in hilly districts, where tunnels will chiefly occur, land is generally not valuable: if the stratum be rock, the additional quantity would be trifling, and in any case the increased cost, I trust, would be well bestowed to accomplish so important an end.

It will frequently happen that the line of the tunnel may not be intended to be *level*; still, the advantage of the proposed arrangement of the gradients will be comparative and proportional. The object to be attained is twofold. First, to make each line of railway independent of the mishaps that may happen on the other; and, second, to make the passage through the tunnels, *in each direction*, the easiest portion of the line, in the district or country where they occur.

Amongst the smaller inconveniences of tunnels, viz., the mere annoyance of steam and smoke, without supposing any particular delay or accident; this may be avoided systematically, much more easily with two tunnels than with one. In the police regulations of the road, trains of luggage, coal, or lime, must give way to *coach-trains*. The policeman, therefore, at the entrance of each tunnel, should not allow a luggage-train to enter, if the coach-train may be expected within ten minutes or a quarter of an hour, in order that the tunnel may be clear for the coaches; in which case the train, being enabled by this new principle of gradients to pass rapidly through, will *leave the steam and smoke behind it*. But if there be two sets of lines *in the same tunnel*, this cannot be accomplished, because one coach-train may require to pass through the tunnel three minutes before another, in the *opposite* direction; in which case the last train will have to enter the tunnel just filled with smoke by the previous train; and in calm weather it may be expected

to take a quarter of an hour, and probably more, to get the tunnel clear; a difficulty which can hardly be got over, except by two tunnels.

I am aware that it is proposed "to ventilate the tunnels by shafts in the usual way," but the fact is, that there is no usual way that is efficient in different states of the atmosphere: one day the current of air will be *up* the shafts, another day it will be down the shafts, and in thick calm weather there is frequently no reason why it should be either up or down; the consequence of which will be, that, owing to counteracting gravities and temperatures, the clearing of the tunnel will often be a very slow process.

The arrangement of the opposite gradients will, of course, be practicable in some situations more easily than in others. Where a tunnel occurs at the summit ridge of two inclinations, where assistant power is used, it would perhaps be most easily, and with most apparent benefit, introduced; but there is scarcely any situation in which the *principle of comparative facility in each direction* may not be advantageously adopted.

HENRY BOOTH.

*Liverpool, 1836.*

*Suggestions on Steam Navigation.* BY JOHN MOORE, Esq.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

DEAR SIR,—I beg to hand you a few suggestions on steam navigation. The figure of the vessel, longitudinally, should be the catenary\* curve; the depth of hold, and distance from side to side, the rotation of the curve upon its axis.

The decks to have flat walks and bulwarks for the safety of the men, possessing strength of figure, and affording great room on deck, and within for goods. The waves breaking upon deck would be returned, preventing their passing over, giving great elasticity; nor could a concussion be a direct one, even above its water line, whether from the wave, a sunken rock, or a ship. It should be made of iron, being of less than half the weight of a wooden one, and much stronger, reducing the chance of leakages, and lessening the first cost, and its figure would enable such

\* Our correspondent has forgotten to state what are the proportions he would give to the axes of the catenary.—Ed.



a vessel to lose part of the water's resistance by rising upon it when the steamer's velocity was considerable.

The paddle-wheels of steamers should be separated, that one might be stopped whilst the other continued in motion, or their actions reversed. To prevent accidents, and proper control of the ship, it should be managed by a person on deck.

The condensing should be by cold water passing over the base of a capacious cone.

Steam of greater density should not be used than sufficient for performing its work, because one steam cylinder of water will form 1728 of steam. Shewing that 1727 caloric has mixed with one of water, when the steam has the atmospheric pressure, or 15lb. per square inch: or it might be thus stated, one steam cylinder of water will be required during the time the engine has made 1728 strokes, and when the steam be at

lb. per square inch pressure.	Cylinders of water.	Strokes of the Engine.
30 requiring 1 to every	864	
60 .....	1 .....	432
120 .....	1 .....	216
240 .....	1 .....	108
480 .....	1 .....	54
960 .....	1 .....	27
1920 .....	1 .....	14
3840 .....	1 .....	7
7680 .....	1 .....	4
15360 .....	1 .....	2
30720 .....	1 .....	1

Thus, when the steam is about 30720lb. per square inch, the steam passing out to work the engine requires an equal bulk of water to be passed in, having the resistance of 30720 per square inch, to be overcome before it can be passed within the boiler; such an engine would be useless, because it has no power beyond supplying itself.

The spontaneous ignition of coal in steamers, having to perform long voyages, might be prevented by placing the coal in large cells, separated by thin plate iron, water tight at its joining, having on the deck a man-hole, pump-hole, and a small tube, terminating in a gasometer for retaining the carburetted hydrogen for lighting, cooking, and warming of the ship. Suppose the gas in either of the tubes indicates the coal was approaching ignition, then, upon removing the cover of the pump-hole, and pouring water through it until the coal in that cell was cooled and its gas

expelled; the danger to ignite would be removed, and the pump would withdraw the water.

Sometimes it might be well to promote the tendency wet coal has to ignite, by mixing with it either iron or sulphur, should the coal not possess both, that the supply of hydrogen might be sufficient.

I am, Sir, yours, &c.

JOHN MOORE.

*Bristol, Jan. 9, 1837.*

*Upper Works of Railways, in a Report to the Directors of the Midland Counties Railway.* By CHARLES VIGNOLES, Esq., C.E., &c., &c.

WE gave a small portion of the following Report in our last, but could not, as we intended, give the whole, owing to the late time of its reaching us.

Independent of the importance of the subject in the reduction of first cost, we have no doubt, if successful, it will materially reduce the wear and tear, by destroying, by its elasticity, the effects of the percussions on the inflexible blocks. We have little doubt, too, that an elastic bearing of this kind will much deaden the rumbling noise now so perceivable on railways, and render the travelling much pleasanter. We are informed, that in America, where this plan is partially adopted, the change from stone to wood bearings is instantly perceived by the travellers, and is very agreeable to them.—Ed.

*To the Directors of the Midland Counties Railway.*

GENTLEMEN,—I have, in a former Report, submitted to you, and I beg again to urge the propriety and policy of the Directors taking into their most serious consideration, the mode of executing the *Upper Works* of the railway in a more economical, and, in my judgment, in a better manner than the method adopted on the London and Birmingham Railway, and some of the other principal lines now in course of construction—I mean the adoption of a railway bar of a peculiarly strong section, though lighter than usual, to be laid upon half baulks of kyanized timber, longitudinally placed, and supporting the rail throughout its entire length, without chairs, or with chairs at the joints only, the rail being nailed or spiked down on the timber.

I have already explained that the motion of the trains on a railway thus laid, will be much easier, and indeed I believe this

is admitted on all hands; such a line will be much more cheaply kept in repair, and vastly less damage from concussion and vibration will be sustained by the engines and carriages, and by the road itself.

I have been studying this subject at every available moment for a long time, and from the experience of eighteen months on the Dublin and Kingstown line of the *longitudinal timbers*, I am more and more convinced that the true principle of forming the Upper Works of a railway, is by placing the rails sustained throughout the entire length on wood, and as soon as it is resolved to sustain the rail in this manner throughout, it follows as a consequence that cast-iron rails may at once be thus placed, in preference to, or at all events in competition with, wrought-iron rails.

The chief objection against the cast-iron rail, has ever been the number of joints, but I have ascertained that rails of the pattern I recommend, can be cast with accuracy in lengths of twelve feet; indeed, I have made a contract for a quantity to be delivered, free from all warp: and this admitted, there are several advantages which cast-iron possesses over wrought-iron, that will justify its adoption for railway bars sustained throughout on longitudinal timbers, in the manner I propose; the absence of all lamination on the bearing surface, and the bringing of the manufacturers of wrought and cast-iron into greater competition for the supply of railway companies, are each important features in the case.

If it would be any argument to gentlemen who are quite capable of exercising their own judgment, I should say that two or three railway companies, for whom I am engineer, and who are about to apply to Parliament for incorporation in the next session, have resolved to adopt the principle of laying rails on baulks of timber, and I shall equally recommend it to several other companies for whom I am concerned as principal or as consulting engineer.

The accompanying statement will show the manner in which the saving is effected; I have taken great pains to price everything as fairly as possible, and I am persuaded that for stone blocks and ballasting, the price on many parts of the Midland Counties Railway will exceed what I have estimated, from the great distance of land carriage of the stone, and the want of ballasting materials in the district, I am indeed of opinion that the ultimate saving will be for this Company, 2,000*l.* per mile; and, looking to the system extending to other parts of the country, I venture to assert that in the alluvial districts of England, the difference will often amount to more.

The saving of 2,000*l.* per mile upon the whole sixty miles authorized for construction under the Company's Act, is no less than 120,000*l.*, an item much too large to be put aside without the gravest consideration from the Directors.

Looking at the question in the most discouraging light, little or no loss can accrue to the Company from the adoption of the

measure—admitting the necessity of renewing the timber every seven years, the total cost at the end of twenty years will scarcely be more than the present positive outlay, and we have a right to claim credit for compound interest on the saving of first capital—besides, blocks and chairs break and require renewing; and there can be no question of the much greater annual economy of keeping such a line as I propose in repair, and the less destructive effect on the trains.

The preference which might be made of wrought-iron over cast-iron, cannot interfere with a principle which rests solely on the placing a continuous support of timber below the rail, dispensing with the use of chairs.

The substitution of wrought-iron would, however, allow a lighter rail, but with wrought-iron the amount of saving would be from 200*l.* to 400*l.* per mile less than by adopting cast-iron.

In the subsequent comparison, I have stated the expense of the railway laid on stone blocks, and also on sleepers; I have a right to consider the whole as laid on blocks, and I calculate as if this were done in the first instance; but practically the estimate will be increased, inasmuch as sleepers are laid on embankments with the avowed intention of being replaced, after a few years, by blocks.

The scantling of timber I have selected, has been fixed by having determined the economy which would arise by using Brack or second Memel timber, which can be procured in baulks of nearly equal section throughout, and varying very little more than from about 13½ to 14 inches square.

In selecting these tie pieces of timber, I have considered that they come in almost for nothing; but if an equal economy in the sawing up of the timber can be otherwise obtained, wrought-iron rods of small diameter might be placed every three or four yards, solely for the purpose of keeping the railway track in guage.

The rail I have selected will weigh, in cast-iron, about 48*lbs.* per lineal yard. If of wrought-iron, it would be reduced (by diminishing the thickness of the lower bearing) to 42*lbs.* per yard.

The timber being laid on its broadest side, the rail will be spiked or nailed down thereupon, the guage of the track between the two rails being preserved by the 2-inch tie pieces, 7 feet 6 inches long, being let into the longitudinal timbers at intervals of 7½ feet.

The statement, as follows, is drawn up as the comparative estimate of the cost of the present mode of laying rails on stone blocks and on wood sleepers, and of the proposed method for laying the railway, on the line of the Midland Counties Railway, and which, with the necessary addition for the extra price of materials and extra carriage, may serve for most of the railways throughout Great Britain and Ireland.

*Estimate of the Present and of the Proposed Methods of laying Railways computed for the Cost of One Lineal Yard of Double Trackway.*

PRESENT MODE OF LAYING RAILS.

*On Larch Sleepers.*

	s.	d.
Kyanized larch sleepers, containing about 2 cubic feet of timber at 4s. 6d. each (placed at intervals of 4 feet), 2 sleepers for a double track equal to, per yard . . .	6	9
Ballasting, including the rubble drains in the bed of the road, 4 cubic yards in a yard forward, at 2s. . .	8	0
Rails, 62lbs. per yard of wrought-iron, at 13l. per ton.—Chairs, 18lbs. each, and joint chairs 20lbs. (placed at intervals of 4 feet), equal to 14lbs. per yard of cast-iron, at 10l. per ton, including carriage and delivery on ground . . .	33	10
Spikes, 3d. each; 4 compressed wood keys, 4½d. each; chairing two sleepers, 2½d. each, equal to per yard (the intervals being of four feet) . . .	2	11
Laying Railway, including boxing up and adjusting . . .	1	6
Total per yard of double track . . .	53	0
Or, 4664l. per mile.		

*On Stone Blocks.*

Stone blocks, of 5 cubic feet each, at 4s. each (placed at intervals of 4 feet), four blocks per double track, which is equal to per yard . . .	12	0
Ballasting, including the rubble drains in the bed of the road, 5 cubic yards, in a yard forward, at 2s. . .	10	0
Rails, 62lbs. per yard, of wrought-iron, at 13l. per ton.—Chairs, 18lbs. each, and joint chairs 20lbs. (placed at intervals of 4 feet) equal to 14lbs. per yard of cast iron, at 10l. per ton, including carriage and delivery on ground . . .	33	10
8 Spikes, 3d. each, 4 compressed wood keys, 4½d. each, 4 felts, 1d. each; chairing and drilling four blocks, 3d. each, (the intervals being of 4 feet), equal to per yard . . .	5	7
Laying railway, including boxing up and adjusting . . .	2	7
Total per yard of double track . . .	62	0
Or, 5456l. per mile.		

Sleepers are considered a temporary expedient, and are calculated to be replaced after a certain term with stone blocks, and supposing one-third of the railway to be at first laid on sleepers, the loss would be 8s. 7d. per yard, or as one-third only is laid 2s. 10d. per yard, or 210*l.* per mile, to add to the ultimate cost of the road, making it amount to 64s. 10d. per yard, or 5666*l.* per mile.

The FIRST COST of a railway, two-thirds being laid on stone blocks and one-third on sleepers, would be 5192*l.* per mile.

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PROPOSED MODE.

*On Memel Baulks.*

	s.	d.
Brack or 2d Memel timber, 13½ to fourteen inches square, cut into 4 slabs of 9 × 4 inches; the extra piece cut into tie or guage pieces, 2 inches thick and 7½ feet long, to be placed at 2½ yards length; in all 3½, or say 4 cubic feet, at 2s. 8d. per cubic foot, cut and kyanized	10	8
Ballasting, including the rubble drains in the bed of the road, 4 cubic yards, in a yard forward, at 2s.	8	0
Cast-iron rails, 48lbs. per yard, at 10 <i>l.</i> per ton, including carriage and delivery on the ground.—N.B. Wrought-iron rails, 42lbs. per yard, would be 19s. 6d., and wrought-iron rail 48lbs. per yard, would be 22s. 3d., at 13 <i>l.</i> per ton	17	2
11 Spikes, per yard, the holes for spiking down being cast with the rail (nothing else is required) at 1½d. per spike	1	5
Laying railway, including scarfing, baulks, ties, and adjusting	1	9
Total per yard, of double track	39	0
Or, 3432 <i>l.</i> per mile.		

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With wrought-iron rails, of 42lbs. per yard . . . 41 4  
Or, 3637*l.* per mile.

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With 43lbs. wrought-iron rails . . . 42 9  
Or, 3762*l.* per mile.

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With 48lbs. wrought-iron rails . . . 44 1  
Or, 3879*l.* per mile.

*The following is a comparative Abstract of the total Cost per Mile of the Upper Works of a Railway according to the several preceding stated Methods :—*

	Per Mile of Double Tracking.
Ultimate cost under the present system of a railway, laid on stone blocks, with 62lbs. wrought-iron rails, after replacing one-third assumed to have been temporarily laid on larch sleepers in the first instance . . . . .	£ 5,666
First cost of a railway wholly laid on stone blocks with similar rails . . . . .	5,456
First cost of a railway laid two-thirds on stone blocks and one-third on larch sleepers with similar rails . . . . .	5,192
First cost of a railway wholly laid on larch sleepers with similar rails . . . . .	4,664
First cost under the proposed system of a railway laid on longitudinal baulks of Memel timber, with 48lbs. wrought-iron rails . . . . .	3,879
Ditto ditto with 45lbs. wrought-iron rails . . . . .	3,762
Ditto ditto with 42lbs. wrought-iron rails . . . . .	3,637
Ditto ditto with 48lbs. cast-iron rails . . . . .	3,432

It will thus be manifest that there is an economy varying from 800*l.* to 2200*l.* per mile, and that the most disadvantageous comparison of the proposed with the present system, exhibits a saving in its favour equal to once wholly removing the longitudinal timbers, while taking the 42lbs. wrought-iron rail, which if wrought-iron should be preferred, I recommend as quite sufficient, and comparing it with first cost of a railway wholly laid on stone blocks, there is an actual saving of 1800*l.* per mile, or comparing it with a railway laid two-thirds on stone and one-third on larch sleepers, there is a positive saving of upwards of 1500*l.* per mile in the first instance, and an ultimate saving of full 2000*l.* per mile.

I have the honour to be, gentlemen,

Your very obedient servant,

CHARLES VIGNOLES, Engineer.

4, Trafalgar-square, London, Nov. 25, 1836.

*Extract from a letter to the Editor of the Railway Magazine.*

SIR,—May I beg of you the insertion of Mr. Vignoles' Report on the Upper Works of Railways in your very interesting and very useful Magazine. As a spectator of the proceedings of these great works (railways), I have from time to time been struck with the opposing statements of en-

gineers; one session we have them stating that they have obtained the *best possible line*, say to Brighton, or the South Union from Manchester, or the Cheshire Junction, or any other, by which assertions their committee have been misled and put to a great expense; no sooner, however, has Parliament refused their sanction to these schemes, than the engineer declares he has found a *still better*, and a *still better*!

It is a great pity that some uniform plan of referring all lines whatever to an impartial board of engineers for their approval, should not have been adopted previously to so many Bills having been passed. If such a plan had been adopted, so many new lines could not have sprung up, whose only chance of success is by obtaining part, if not all the traffic, which the company already in operation has been forced to prove to the satisfaction of Parliament, does exist, and which of course that company has a right to, and which cannot be taken away without committing a flagrant wrong; such a wrong as those companies can fearlessly trust to Parliament not to sanction. I do not like engineers, at least, I should say, I cordially dislike their everlasting jealousies and bickerings; from a pretty regular perusal of your pages, I have seen, or thought I have seen, the interests of companies sacrificed to gratify these unworthy jealousies. Any one by looking at the map and examining railways as laid down, would at once see that from some reason or other, (*what it is I do not know*,) the easiest made, and of course the cheapest, the *nearest*, and the most populous line from Leeds, Wakefield, Chesterfield to London, has not been taken; that is to say, the populous and exceedingly rich mineral valley of the Erewash has been diverged from, and a circuitous, bad, expensive line has been obtained by going through a mile of tunnel, near Chesterfield, with a curve in it, in order to get into the Derwent valley and round by Derby, a circuit of several miles, besides getting into more valuable property and a much worse line, as my informant states, and he is, I am confident, correct from other information which I have obtained. The Midland Counties Railway are I observe going to Parliament for an extension of their line to the very point south of Chesterfield, which is so plainly the best for the public at large, and I should think, by inspecting the map, best for the North Midland Counties also. We Sheffielders do not think we have been well used by that company, but we would forgive them all past injuries, if they would give us and the rest of Yorkshire the best line to



London, now the opportunity has been offered them. If you will have the goodness to insert this in your next, I perhaps may trouble you again by and by.

YOUR CONSTANT READER, AND NOT A COAL-OWNER.

Sheffield, Dec. 15, 1837.

*Oxford and Tring Railway.* BY A TRING SHAREHOLDER.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—I am happy to find by an article in the Railway Magazine for this month under the head of “Cheltenham, Oxford, and Tring Railway,” that you have lent the weight of your influence in *exposing the absurdity of proceeding to Parliament to obtain an Act for this scheme.*

I happen to be so unfortunate as, during the railway mania, to have purchased some shares in the Tring Company, under certainly some erroneous notions. The other day I met with a pamphlet called, “A Voice from Cheltenham,” which completely satisfied me that the better plan for the shareholders would be, to divide the money in hand among themselves (*affording a return of upwards of 4l. per share*), instead of allowing the professional men to pocket it, *under a pretence of serving our interests*, by endeavouring to obtain an Act, *which they well know they cannot do.* But here is the rub—although every shareholder to whom I have spoken is of the same opinion with myself, viz., that it is prudent and advisable to abandon further proceedings, and to divide the money in hand, yet our solicitors are stated to have advised that such a course cannot be adopted by a mere *majority* of shareholders, but that *every individual* must consent before this mode can be acted on.\*

\* However absurd this may appear we believe it is true in the generality of deeds for railways. The shareholders, when they “sign the deed,” as it is called, usually sign two—one agreeable to the standing orders, and the other authorizing the provisional committee to proceed to obtain a Bill. Having done this they cannot, as our correspondent has been rightly informed, retract the authority, unless every individual who subscribed, or who represents a subscriber, should consent. Hard as this may at first sight appear, it is nevertheless very proper. If it were not so, a few individuals may, by watching time and opportunity, call a public meeting and destroy the best planned project in the world, even after it had passed both Houses, provided it was before the Royal Assent was obtained. Thus might the labours of the committee be destroyed, and a valuable scheme

Now this does seem to me most preposterous and contrary to all common sense. I am extremely reluctant to trouble you on such a subject, and to such a length; but since you are recognised as a sound authority in railway matters, and are regarded both here as well as elsewhere as a court of the last resort, and from which there is no appeal, you will oblige not only myself, but, I am sure, a large portion of the community, by informing us in your next number, whether our law or the rules of Parliament be such, that the whole body of shareholders in a particular scheme are not bound by a resolution of the majority at a general public meeting properly convened, but that in order to bind the whole the consent of each individual must be obtained.

This appears to me to be a question of considerable moment, and as such will, I trust, be deemed an apology for the trouble I give you.

I am, Sir, yours, &c.

A TRING SHAREHOLDER.

P.S. I forward my copy of the pamphlet, which you will perceive has been prepared on the strength of the Parliamentary evidence during last session, and BEFORE the plans were deposited. These plans have since been deposited (30th Nov. last), and disclose a very different, and *much worse* view of the Tring line than is afforded by the Parliamentary evidence. The writer of the pamphlet has therefore *very much understated* the objections to the Tring line, as is indeed manifest from the extracts in your January Magazine.

both to the shareholders and to the public be marred on the very threshold of its success. Such attempts are therefore very wisely provided against.

But the case of our correspondent is very different. A rival line, it seems (the Swindon), has actually obtained a Bill, and, we presume, therefore, rendered unnecessary the Oxford and Tring. Now if at a well-attended public meeting of the shareholders, it should appear to the majority, that the measure ought not to be proceeded with, the provisional committee might call a public meeting by virtue of the authority vested in them, and whatever the majority should then determine on, the whole are bound to obey. The committee, it should be observed, are not legally compelled to call such a meeting; but if the opinion of a public meeting that they ought to do it should be disregarded, and they should afterwards persist in prosecuting the measure and fail, it becomes a question whether in equity they would not be personally liable to make good all expenses and deficiencies after receiving and disregarding the meeting's request. We have seen a very well-written letter on the subject of these opposing lines, in a pamphlet entitled a "Voice from Cheltenham." If all the statements therein made be true, it is a curious affair on the part of the Tring Company; but if not, we suppose they must long ere this have been answered, which we have not heard of.—Ep.

*Oxford and Tring Line.*

OUR readers will remember that an article appeared in our last number, in which were some statements contradicting from documentary evidence a public advertisement put forth by the committee of the above proposed measure, and signed by their chairman, Mr. Pearson Thompson. As the differences were so many, great, and various, between the advertisement and opposing statement, as to show that one party or the other must have been guilty of deliberate misrepresentation, it excited from us some remarks, and an invitation to the Tring party to answer the document if they could. The publication of the statement and our remarks thereon have occasioned, we hear, a very strong sensation throughout the country generally, and more particularly through the parts interested. Every one is anxiously looking forward to know what course will be taken, and answer given. Our communication was received from a very respectable quarter, and the author of it we know and believe to be incapable of descending to wilful untruth; but should it appear that he has, we will instantly give up his name. Indeed he has voluntarily authorized us to do so.

Under these circumstances we have been waiting day after day, to give the Tring gentlemen an opportunity of disproving the charges of misstatement and misrepresentation made against them; for we have no desire but to give them fair play. Hitherto, however, nothing has reached us but a printed document sent by some anonymous individual, which it seems has been published as an advertisement in the provincial papers; and which document, it appears to us, is a complete evasion of the matter in question. We have, however, taken the trouble to send it to a friend who is more intimately acquainted with the various points of the subject, and whom we hold responsible for all he says. His remarks exactly confirm our previous view, namely, that it is not an answer to any one point, but a go-by to them all. They go even a great deal farther, but we have nothing now to do with any other matter than that which is before us in our last number.

Here are statements deliberately drawn up by a committee of gentlemen, and advertised by them in the public newspapers, signed by their chairman. Either these statements are true, or they are false. A gentlemen in our last declares they are untrue, and points out the places and

quantities of misrepresentation. The simple question then is, does our correspondent's figures admit of explanation or disproof. At present they are ugly spots on the fair fame and fair dealing of the Cheltenham, Oxford, and Tring Committee. If they can wipe them out by direct and candid means, we assure them they shall have free use of our pages; more we can hardly say.—ED.

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*Experiments on Interference of Light.* BY THE EDITOR.

A GREAT deal having been said lately on the subject of the Interference of Light, I have thought it not amiss to publish here an experiment I made several years ago, but never published, and some time since accidentally turned to in the course of my other experiments on light, which appeared to me conclusive against the notions of Dr. Young regarding the cause of the bands of light then a few years ago discovered.

*Optical Experiment.*

I put a double convex lens whose upper surface had a curvature of 17.5 inches radius with the other surface of 23.7 inches radius of curvature, on a double concave lens whose surface of contact was 25 inches radius of curvature. The lenses thus united I put in a small card box, blacked over inside and out with Indian ink, open at one end, and with a perpendicular aperture of three-tenths of an inch horizontally, one and inch three-tenths vertically. With this apparatus I examined the effect on the Newtonian rings, of a pencil of light reflected from a mirror about twenty feet from my window-shutter and intromitted through a hole one-fifth of an inch diameter, then decomposed by an excellent prism, and thrown on a large sheet of white paper in a darkened room twenty-three feet two inches from the hole; though I wiped the glass with the greatest care, I found I could not maintain a complete central contact, for the central point was not perfectly opaque from reflection, but rather white.

After remaining in the room a considerable time, to enable my eyes to accommodate themselves to the faint light I had to observe, I allowed a part of the coloured spectrum to fall through the vertical aperture on the central contact of the glasses, and tried to get a sight of Mr. Knox's rectilinear intersectionaries. It was, however, with

great difficulty I could effect this on account of the great attenuations of the light on which they were to be seen, and my eyes having for a long time being unused to such phenomena. Nor except in the green and sometimes in the red could I see them at all; in observing, however, the faint light which is scattered like an arm across the vertical spectrum, it is seen that the primary set of rings and its reflected set, intersect each other, so that the black intervals mutually divide the light parts into little diamond sections of brilliant light. In the space of the first five or six, or visible rings, these diamond sections are very visible and distinct, and nothing in the shape of Mr. Knox's intersectionaries appears; but as the distance from the centre increases, these intersectionaries become more visible.

Examining them a little closer I observe that in the second light, or that in which the secondary set is visible, this secondary set is divided not only by the black intervals between its own rings, but by the black intervals belonging to the primary set. On the contrary, in the light in which the primary alone is visible none of this intersection of the primary set by the secondary appears; but the primary set appears entire and unaffected by the other set. Hence, therefore, we should immediately conclude that Mr. Knox's intersectionaries must appear in the attenuated light only in which the secondary set is to be seen; which is indeed the case.

I should here observe, that the breadth of the light part of the rings exceeded that of the dark intervals in the ratio apparently of 4, 5, or 6 to 1.

*Cranford, April 19, 1824.*

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### *What will Parliament do with the Railways?*

BY THE EDITOR.

PARLIAMENT, we hear, is in no very kindly mood towards these projects; and the all-absorbing question is, "What course will they take?" It is evident something must be done. The injustice to the country, of permitting money to be squandered away in the immense sums in which it is in Parliamentary contests, is what can no longer with any honest feeling be tolerated. Thirty-six railway Bills passed last session, either for new lines or alterations.

Supposing these cost, one with the other, only 10,000*l*.

apiece, the enormous sum of 360,000*l.*, or between a quarter and a half a million of money—a sum sufficient in America to make 100 or 120 miles of railroad—was actually spent in Parliamentary squabbles. If a like sum was to be spent on each of the 99, whose plans are deposited, the total expenditure would amount to very nearly a million of money!

In one of the contests, last year, upwards of 100,000*l.* are said to have been spent, and what was gained? nothing, literally nothing, for all the Bills were thrown out. "On the Brighton line, alone," said Mr. Pearson, in an eloquent speech at Brighton, "there were about twenty counsel engaged, headed by six king's sergeants and king's counsel. There was a regiment of above twenty eminent solicitors of London and Brighton, flanked by a whole brigade of Parliamentary agents, [of which Mr. P. himself was one. Who would believe there was so much honesty in the profession?], and a whole array of surveyors and engineers, whose chief business, it appeared to be, to contradict each other, [the lawyers aiding, and assisting, and chuckling with delight.] To the best of his recollection they were engaged fifty-two days before the Commons, at an expense of 1,100*l.* a-day." Here then upwards of 57,000*l.* was spent in the Commons, all the fruits of which were destroyed by a single vote in the Lords.

Now we perfectly agree with Mr. Pearson, that it does appear as if "the chief business of the witnesses was to contradict each other." But is not this principally owing to the lawyers? I myself was present on one occasion, and heard a certain engineer cut up and exposed by counsel in such a manner, as would induce any one to believe him the greatest charlatan, blockhead, and ninny, the country had. In the same day, I am informed, or very shortly afterwards, the counsel walked into another committee, and happening to be on the same side, then extolled the man he had just so unmercifully abused and degraded, as a perfect paragon of excellence and skill. What conduct was this? ought it for a single moment to be tolerated?

Mr. Pearson observes, with respect to engineering points, "Of all possible tribunals for the consideration of such questions, a Committee of the House of Commons was one which enjoyed and deserved the least of public confidence. This was universally admitted by their own members—they could not separate themselves from the control of party and personal influences—they had no professional reputation to

peril by an erroneous judgment in engineering questions; and at the period of the year at which they conducted the inquiry, the country was clothed with standing crops, when, if they desired to bring a disputed level to the test of actual examination, they could not do so, but were obliged to receive bold and impudent assertions, which were met by perhaps as bold and impudent contradictions, without having the means of attesting the accuracy of either."

In all this we perfectly concur; but the difficulty is the remedy. If Committees of the Legislature are to decide, would it not be better to exclude lawyers altogether, and bring the engineers to interrogate and examine each other, or to be interrogated by the Committee? By this means we should get at truth in its simplest form and shortest course. It will be urged that the lawyers prevent inadmissible evidence. A fig for the technical shades of evidence, we want truth; we care not a farthing about the exact form of it. Which is it best to have, that which we can depend on in a homely garb, or to hire men at extravagant prices to do all ingenuity can devise to conceal truth and advance that which is not worth a straw? But in several cases this very method has been adopted—lawyers are not obliged to be employed—and, as I have heard from some of the parties concerned, has succeeded admirably.

Supposing, however, it be needful to employ legal gentlemen, then I know no simpler and more efficient method than that I recommended in a letter to the Duke of Wellington in our sixth number, which probably, at this moment, I cannot do better than transcribe:—

"Now it has occurred to me, that if these cases were referred to the ordinary courts of law, before our judges and a common jury, the chances of a speedy and just decision would be much greater. Increasing the number of judges would enable them to despatch the business before them so as to attend to matters of this sort, and particularly if a little use was made of the long vacation. An augmentation of salary would of course be needful, which might very well be paid by the Government charging each company that came for a Bill a certain sum, either per day, week, or otherwise, so as to save the public purse. The juries too might be paid, but not directly by the companies. Judges being independent of all parties, compelled to attend from the duties of office, able from their education to meet and control the manœuvres of counsel, and having that grand desideratum for the despatch of business, unity of action,

would in my opinion get through more cases in a week than a committee would in a session. And if they were inclined to peculate, the risk of place, with the controlling influence of the public press, and the impossibility of screening themselves by throwing the sin upon a body as in committees, would be powerful checks. If it be urged that ordinary juries would be incompetent—which I am by no means satisfied of, under the guidance of a judge—let them be composed of men of science and engineers, who should be liberally paid, after decision, by a tax on the company, ordered by the Parliament or judge. And let these too be amenable to public opinion by the publication of their several reasons for their decision, having previously made these jurors as honest as possible by severe oaths, embracing the past, present, and future tenses, of having no direct or indirect interest, connexion, or benefit from the proposed measure, its friends, or advocates. If all such proceedings were published six months prior to their being brought under the notice of Parliament there would be time for investigation; and if the cases were then finally disposed of before the whole House, there would probably be but little reason to complain hereafter of haste or want of justice. We should by this means save much valuable time to the members of the Houses, and the waste probably of some millions on injudicious schemes, which a few years may show to be so worthless as to compel the construction of better."

Either a plan of this sort should be adopted, which I think, under all circumstances, would turn out to be the most effectual and useful, or we must have recourse to a commission as in Ireland.

There is no doubt but a commission would do very well if it was composed of competent men, and they could be made responsible for the accuracy of their decisions. In the case of rival lines it would probably be a very good preliminary measure. For instance, to Brighton there are five lines. The sections of all have been in my hands, and, from what I have seen, I am perfectly satisfied that one week would be sufficient for any competent person to decide, if he had all the plans and particulars before him, on the respective merits of these projects, and determine truly which was the best. But it would require a person of some skill and science.

In one of these lines I was struck with a curious fact, namely, that one of the engineers had laid out his line on principles directly opposite to those he has over and over



advocated in both Houses. It could not be that he was compelled to do so, because another engineer has followed the very opposite course. The question is, will the former gentleman, now, in the teeth of all he has said, go in and support, as the best of all possible schemes, his present line to Brighton? We shall see.—Ed.

## MISCELLANEOUS AND SCIENTIFIC INTELLIGENCE.

*Snow on Railways.*—Great surprise has been manifested from the late experience on the Liverpool and Manchester, Greenwich, Whitby and Pickering, Newcastle and Carlisle, Railways, &c., that snow has formed little or no impediment to them. If we consider the great weight and momentum of the trains, with the extreme levity of the snow, we shall not be surprised at this. A passenger train is seldom less than thirty tons. Now, at a velocity of thirty miles an hour, or forty-four feet per second, it has a velocity equal to that acquired by the whole mass falling through a free space of thirty feet. Can any one for a moment suppose that a mass of thirty tons having acquired the velocity due to a height of thirty feet, or, which is nearly the same, that an iron-shell of two cwt. falling from a height of 360 yards, would find any difficulty in penetrating a 100 feet, or perhaps even a 100 yards, through snow? We have but little doubt, if the experiment could be made, that any one of the Liverpool trains would instantaneously cut itself a passage through a snow-drift of 100 feet long; but it must take care of its engine chimney and glass.

*Preservation of Fruit.*—M. Loiseleur Deslongchamps has announced to the French Academy of Sciences that he has found a simple and inexpensive method of preserving fruit. His plan has been referred to a commission, and as soon as its efficacy is decided on will be made public.

*New Plan of Bricks for Chimneys.*—The following is Mr. Gompertz's reason for his new plan of bricks, which came too late for our last number.—Ed.]—The reason why rhomboid bricks are stronger than oblong ones used in the common way, is evidently because the line of mortar which must break is much longer than across the chimney, and these bricks also forming a sort of leverage to resist the breaking. The chimney with them must either, if blown down, break in this long line of mortar, or the bricks themselves must break, and bricks are much stronger than mortar. Probably, however, there may be some chance of the rhomboid bricks slipping down by their own weight, though I do not much apprehend it.

*Recent Canal-boat Experiments by John Macneil, Esq., M.I.C.E., F.R.A.S., M.R.I.A.*—Mr. Macneil has made se-

veral experiments at the suggestion of the Committee of Management of the Forth and Clyde Canal Company. The character of these experiments is the same as that of those given to the British Association, recorded in our 8th No. p. 316, by Mr. Russell, and apparently had the same objects in view. The experiments made by Mr. Macneil amount to a very large number, and appear to have been conducted with great care and skill. They confirm in general the results obtained by Mr. Russell, but do not appear to have been carried to the length of the latter gentleman's. The following are the inferences Mr. Macneil, in his report to the Institution of Civil Engineers, has drawn from them :—

1. That in the wide and deep canal, the tractive power was observed to increase with the velocity, but not in any uniform ratio.

2. That in the shallow and narrow canals, the increase of tractive power had a limit at a certain velocity; and, under certain circumstances, even decreased with the increase of velocity; so that it appears probable, that if the size of the canal bear a certain proportion to that of the boat, there is a certain velocity at which a boat may be drawn on a canal with a minimum tractive power. This velocity, on the Monkland and Paisley Canals, with boats like the Zephyr and the Swift, appears to be about nine miles per hour. And I think it probable that a similar effect would be observed on the Forth and Clyde Canal, if a boat similarly proportioned to that canal were used, though the velocity and the minimum tractive power in such a case might be different from those on the other canals.

3. That, in the long-run on the Forth and Clyde Canal, the surface of the water, regarded on the side of the boat, when in motion, was concave or hollow about the middle of the length of the boat, rising at the bow and quarter.

4. That, in the long-run on the Paisley Canal, precisely the opposite effect took place, the surface of the water about the middle of the length of the boat being convex, and higher there than at the bow and quarter.

5. That there appears a relation between the tractive power and the horizontal position of the keel, the tractive power, it will be observed, diminishing and increasing in some ratio or other, as the angle of variation is smaller or larger.

6. That the boat absolutely rises during its motion. This fact was most satisfactorily demonstrated by the apparatus designed for the purpose. In some of the experiments, the mean of the several rises indicated by the four slips, was about four inches, the bow being, in every case, more elevated than the middle and stern.

*Wells of Fire.*—In the province of Xensi, China, there are wells from which fire issues, which the inhabitants use for domestic purposes. It is said this fire is not very brilliant or transparent,

but very hot and is supposed to arise from the combustion of carburetted hydrogen. Wood thrown into it would not burn ; and by introducing bamboo tubes the flame may be conducted almost wherever one wishes, and the food slowly cooked by it.

*On the Construction of Public Buildings in reference to the Communication of Sound.* By Dr. D. B. Reid.—Dr. Reid maintained, from numerous experiments made in the open air in the neighbourhood of Edinburgh, in which he was assisted by a number of gentlemen, and also from a comparison of his class-room with many other buildings, that any difficulty in the communication of sound in large rooms arises generally from the interruption of sound produced by a prolonged reverberation, and, comparatively, rarely from a deficiency in the voice of the speaker. The human voice had been heard distinctly at the distance of a mile and upwards in a calm atmosphere. Sir John Ross, Lieutenant Bowen, and many others, had borne testimony to this fact ; and in the experiments above alluded to, in the open air, individuals conversed easily at a distance varying from 200 to 1000 feet, when it was calm. In many rooms, in consequence of the repeated reflections between wall and wall, or between roof and roof, the sound of the voice might be heard continued many seconds after the individual trying the experiment had ceased to speak. In a newly fitted up leaden chamber for the manufactory of oil of vitriol, the sound was heard prolonged for seven seconds ; and when the different notes of any chord were sounded successively by any individual, they were afterwards heard blending harmoniously in one compound tone. The leaden chamber was 80 feet long, 15 broad, and 16 high. In numerous public buildings similar effects are observed ; but if the walls be made rough and irregular, so as to lose all resilient power, and hung with drapery, the reverberation ceases. On the same principle, the reflecting power of the floor being taken away by a crowded audience, sound is very different in such an apartment from what is observed when it is comparatively empty. The distinction between the actual amount of sound and purity of intonation has not been sufficiently attended to. Much sound may be produced when the primary impulse is strengthened by combination with the reflected sound of many preceding words, but it has none of that harmony and distinctness which is observed when the primary sound alone is allowed to fall upon the ear. The sound of cannon has been heard at the distance of 300 miles ; Captain Stoddart's account that the firing of cannon in the Baltic is heard at this distance, affords the most ample and specific information on this subject. The sound of volcanic eruptions has been heard at a distance of nearly 900 miles. It cannot be doubted that the repeated reflection of preceding sounds must interfere most materially with those that succeed ; and from what has been above stated, it is obvious that such reflections must be continued frequently to a great extent in numerous apartments.

In constructing buildings, the following circumstances require to be particularly noticed.

In the most perfect form of building for the communication of sound, any reflected sound must be prevented from continuing so as to interrupt any new tone, by being thrown upon a non-reflecting floor, so long as the reflected sound comes up in time to strengthen the primary impulse before any new sound is heard, it is to be taken advantage of; beyond this it is injurious. A building having low walls, rough and irregular on the surface, an inclined roof terminating in a ridge in the centre, and having any elevation there that might be necessary, the material of which it is made having great reflecting power, with a roof matted and arranged so as to absorb all pulses of sound, would be best adapted for this purpose.

All superfluous space should be excluded.

The air should be maintained as uniformly equal as possible.

All concave surfaces ought to be avoided; foci, in such cases, collecting the sound at one point, while in other places it is comparatively deficient.

Dr. Reid, after alluding to the peculiarities in the construction of his class-room and to many other buildings, adverted to a number of circumstances connected with the roof, walls, and floor of different buildings, the introduction of ornaments, the variety of form that might be adopted, according as the walls, roof, &c. were made to reflect or absorb sounds, and the different conditions to be attended to where the speaker was confined to one spot, and where individuals rose in every place to address an assembly.—*Fifth Report, Brit. S. A.*

*Light.*—The Italian natural philosopher, Melloni, has recently invented a mode of depriving the rays of light of caloric, which seems to open the way to great discoveries respecting the nature of light, when thus insulated. His method is very simple; he passes the sun's rays through a combination of transparent bodies (water, and a particular sort of glass coloured green with oxide of copper), which bodies absorb all the caloric, and but little of the light. The light thus separated from its caloric is very yellow, with a green tinge; and when so concentrated by lenses as to be as bright as the direct ray, the most delicate thermometer does not show the smallest degree of warmth. It has long been known that the prism, besides dividing the ray into its several pencils of colours, separated at one end of the spectrum a pencil of heat making rays, and the other a pencil of chemically acting rays, both perceptible only by their effect; but this mode of severing the heat from the light offered little means of experimenting upon the unadulterated light, of which Melloni's discovery seems to give the philosopher as complete command as he has of the gasses, &c.—*Athenæum*.

We doubt the bearing of these experiments very much. The experiment of the heat making rays has long been discarded.

*Falling Stars.*—In the night of the 11th of December, a great

number of shooting stars were seen at Parma; they are described as more numerous than those observed on November 13. From a quarter before eight till midnight there were no less than fifty, equalling in brilliancy stars of the first order, twelve of which were as bright as Jupiter. From midnight till half-past six in the morning fifteen, resembling stars of the second magnitude, were observed, with a number of smaller size. The direction of the greater portion was from east to west. A nearly similar phenomenon was observed at Parma during the night of the 11th of December, 1833.—*Times*.

*Copying Writing*.—Mr. E. Lannet has submitted a plan to the judgment of the Academy of Sciences, by which he proposes, by an easy process, without altering the writing, and on ordinary unwetted paper, to take several instantaneous impressions of any writing.

*On an Economic Application of Electromagnetic Forces to Manufacturing Purposes*.—By Robert Mallet.—The separation of iron from brass and copper filings, &c., in workshops, for the purpose of the refusion of them into brass, is commonly effected by tedious manual labour. Several bar or horse-shoe magnets are fixed in a wooden handle, and are thrust, in various directions, through a dish or other vessel containing the brass and iron turnings, &c., and when the magnets have become loaded with iron it is swept off from them by frequent strokes of a brush. This is an exceedingly troublesome and inefficacious process.

It appeared to the author that a temporary magnet of great power, formed by the circulation of an electric current, round a bar of iron, might be substituted advantageously.

The following is the arrangement which he has adopted.

Several large round bars of iron are bent into the form of the capital letter U, each leg being about six inches long; they are all coated with coils of silk-covered wire, in the usual way of forming electromagnets of such bars, and are then arranged vertically, at the interval of five or six inches from each other.

All the wires from these coils are collected into one bundle at their respective poles, and there joined into one by soldering, a large wire being placed in the midst of them and amalgamated. A galvanic battery is provided, which, if care be taken in making, the junctions at the poles, &c., need not exceed four, or at most, six pairs of plates, of from twenty inches to two feet square.

The poles of this terminate in cups of mercury, which are so placed, that the large terminate wires of all the coils can be dipped into them or withdrawn easily.

The rest of the arrangement is purely mechanical. The required motions are taken from any first mover, usually a steam-engine. The previously described arrangement being complete, a chain of buckets is so contrived as to carry up and discharge over the top of the magnets a quantity of the mixed metallic particles,

most of the iron adheres to the magnets, while the so-far purified brass falls into a dish or tray placed beneath to receive it.

This latter is also one of a chain of dishes, the horizontal motion of which is so regulated, that the interval between two dishes is immediately under the magnets, in the interval of time between two successive discharges of the mixed particles on the bars.

At this juncture the communication between the galvanic battery and the magnets is interrupted by withdrawing the wires from the cups of mercury, and the result is, that the greatest part of the adhering iron drops off and falls in the space between the two dishes.

The next dish now comes under the magnets, the communications are restored, and a fresh discharge from the buckets takes place, and so the process is continued.

Some iron constantly adheres to the magnets, but this is found of no inconvenience, as it bears but a small proportion to the total quantity separated.

The author has had an imperfect apparatus of the sort above described at work for some time, and has found it to answer; and suggests the application of electromagnets for somewhat analogous objects in various manufactures. He particularly mentions needle and other dry grinding.—*Fifth Report Brit. S. A.*

*Mercurial Boilers.*—In our Eighth Number, p. 313, we noticed that a steam-boat, called the *Vesta*, was plying in the Thames with a mercurial boiler. We are sorry to hear the experiment does not succeed. She is found to be too deficient of that of which kings are said to be particularly fond—power.

*Planton's Railroad Car.*—An American has invented a car with grooved wheels to run on the rails, and independent axles to each wheel. He thinks this will obviate all the difficulties of curves, &c. We ask, what is to become of the increased friction arising from having four flanges instead of two, and how, the wheels being on independent axles, and the tires not conical, the heavy friction in curves arising from centrifugal force is to be got rid of?

*Improvement in Drainage.*—Mr. Barton, the engineer, had an interview with Earl Minto and the other Lords of the Admiralty, a few days ago, respecting his newly-invented patent self-acting pump, for the use of ships at sea, and to supersede manual labour, and which is stated also to be serviceable in adding to the safety and salubrity of the vessel; and which may be applied to various other purposes, either in mines, or wherever large quantities of water require to be discharged. Mr. Barton exhibited a model of his invention to their Lordships, who signified their approbation of its utility.—*Mining Journal.*

*Mineral Tallow.*—Specimens of this substance were lately found in a bog on the borders of Loch Tyne. This curious mineral was first observed by some peasants on the coast of Finland, in 1736; afterwards it was found in one of the Swedish lakes. A similar

substance was found at Strasburg by Dr. Herman, and in this country by professor Jameson. It has the colour, and feel, and taste of tallow, but without smell. It is as volatile and combustible as any of the volatile oils or naphta.—*Mining Journal*.

We have from time to time made several extracts, as our readers have perceived, of valuable scientific information from the *Mining Journal*. It is with great pleasure we see the editor persevere in the same laudable course of enriching his columns with watter both useful and interesting, regardless of expense, and keeping one object in view, the interest and instruction of his readers.—Ed.

## REVIEW OF BOOKS.

*Transactions of the Institution of Civil Engineers.*—The first volume of this Society's Transactions has just appeared. It contains several papers and communications of considerable interest, by distinguished members of the profession, some of them written very well. We have taken out one of them in the present No., and made extracts from another. It was our intention to do the same with two or three others, but want of space prevented us. We may next month return to it.

This volume contains a great number of well-executed plates, and in the Introduction, a history of the Institution, with its laws and regulations, and some interesting biographical sketches of various eminent engineers. The chief fault we have to find with the Introduction is, that the writer appears too much on stilts, and writes in too elevated a strain for the subject. A more simple and business-like narrative would have pleased us better. However, we have perused the sketch with pleasure.

*Wheeler's Visit to Australia.*—The influence of example is generally admitted. When it is founded on virtuous and benevolent principles, it is not surprising that it should excite the desire of imitation, as well in individuals as among larger circles. This hath been the case in the societies that have sent missionaries to heathen nations. The Moravians led the way to cold and barren regions. The Baptists chose the warmer districts of the East. The unenlightened parts of the southern isles were selected by the Missionary Society, composed at first of Churchmen and Dissenters. The Established Church followed, adopting a plan suited to its own forms, and sending its missionaries where its own systems were to be enforced. At length the Society of Friends has engaged in the benevolent enterprise of enlightening those who have long sat in darkness and the shadow of death. A vessel was purchased and fitted out at the expense of Friends, in which Mr. Wheeler and his son embarked. The report of his voyage, and of his

visiting Australia and Port Jackson, &c., is now sent home. It contains much interesting matter, partly because of the dangers through which they passed, and partly because of the reception they met with from the persons they visited. The account is presented in a plain unstudied form, and evinces, in a striking manner, the benefits conferred on the natives by the labours of the missionaries; and also the pernicious effects resulting from the introduction of fermented liquors by the English and Americans who have visited those regions. Though it may excite, in some minds, surprise that utterance was always granted to Mr. Wheeler when the people were assembled to hear, yet the subjects communicated were uniformly of a nature calculated to benefit those to whom they were addressed. Mr. Wheeler records with delight the kind reception he had, and the hearty concurrence of all the missionaries, in the undertaking in which he was engaged. It would be well if the same unity of spirit everywhere prevailed.

Another publication well deserves notice, entitled, "Essays on the Principles of Charitable Institutions," being an attempt to ascertain what are the plans best adapted to improve the physical and moral condition of the lower orders in England. It is said to be the production of a female, but who shows a masculine and benevolent mind. The mode in which the subject is treated, is judicious; the arguments applied are relevant, and their utility will be admitted by every candid reader. There is a seasonableness in their publication, if any practical benefits are to result from the reports of the Commissioners appointed to investigate the national charities. To these the public have looked with anxiety, and it is to be hoped that ere long their expectation will be gratified. The publication to which we allude, is divided into nine essays, with a prospectus of a second class, containing, and connected with, the subjects which have already appeared.

We are concerned to learn, from the preface, that want of health has occasioned a delay in the publication of the second volume. Those by whom the present one is candidly perused, will join us in wishing the writer a speedy restoration, and a long continuance of the blessing of health. At a subsequent period we will give a detail of the subjects discussed, but are fearful that a mere enumeration of them, which is all the space our publication can at present allow, would not be sufficient to afford our readers an opportunity of forming a correct opinion of their importance.

*Belcher's Illustrations of the Scenery on the Line of the Whitby and Pickering Railway.*—We have, in another part of this Magazine, mentioned this book, which is well got up for the subject, and at a great expense. Among the matter, we were particularly struck with the following anecdote of ancient superstition and religious tyranny. We acknowledge it is very little connected with railroads; but as our Transatlantic brother, the Editor of the "American Railroad Journal," sometimes



amuses his readers with a droll story, we thought we might take the liberty of carrying ours, by a sort of railroad leap, to the genuine absurdities of between six and seven centuries back. The subject is the whimsical punishment inflicted on two noblemen for an assault, which ended in the death of a hermit.

*A True Account of the Murder of the Monk of Whitby, by William de Bruce, Lord of Uglebarnby, Ralph de Percy, Lord of Sneaton, and Allatson, a Freeholder: with the Monk's penance laid upon them, to be performed on Ascension Eve, every year, otherwise to forfeit their lands to the Abbot of Whitby.*

In the fifth year of the reign of King Henry the Second, after the conquest of England by William Duke of Normandy, the Lord of Uglebarnby, then called William de Bruce, the Lord of Sneaton, called Ralph de Percy, with a gentleman and freeholder, called Allatson, did, on the 16th day of October, 1159, appoint to meet and hunt the wild boar, in a certain wood or desert place belonging to the Abbot of Whitby; the place's name was Eskdale-side, the Abbots' name was Sedman. Then these gentlemen being met, with their hounds and boar-staves, in the place before mentioned, and there having found a great wild boar, the hounds run him well near about the chapel and hermitage of Eskdale-side, where was a monk of Whitby, who was an hermit. The boar being very sorely pursued, and dead run, took in at the chapel door, there laid him down and presently died. The hermit shut the hounds out of the chapel, and kept himself within at his meditations and prayers, the hounds standing at bay without. The gentlemen in the thick of the wood, being put behind their game, followed the cry of their hounds, and so came to the hermitage, calling on the hermit, who opened the door and came forth, and within they found the boar lying dead; for which the gentlemen in great fury, because their hounds were put from their game, did most violently and cruelly run at the hermit with their boar-staves, whereby he soon after died. Thereupon the gentlemen perceiving and knowing that they were in peril of death, took sanctuary at Scarborough. But at that time, the Abbot being in very great favour with the King, removed them out of the sanctuary, whereby they came in danger of the law, and not to be privileged: but likely to have the severity of the law, which was death for death. But the hermit being a holy and devout man, and at the point of death, sent for the Abbot, and desired him to send for the gentlemen who had wounded him; the Abbot so doing, the gentlemen came, and the hermit being very sick and weak, said unto them, "I am sure to die of those wounds you have given me." The Abbot answered, "They shall as surely die for the same." But the hermit answered, "Not so, for I will freely forgive them my death, if they will be content to be enjoined the penance I shall lay on them for the safeguard of their souls." The gentle-

men being present, bid him save their lives. Then, said the Hermit, "You and yours shall hold your lands of the Abbot of Whitby, and his successors in this manner:—That upon Ascension Day, you or some of you shall come to the wood of the Stray Heads, which is in Eskdale-side, the same day at sunrising, and there shall the Abbot's officer blow his horn, to the intent that you may know how to find him; and he shall deliver unto you, William de Bruce, ten stakes, eleven strout stowers, and eleven yethers, to be cut by you or some of you, with a knife of one penny price: and you, Ralph de Percy, shall take twenty-one of each sort to be cut in the same manner; and you, Allatson, shall take nine of each sort to be cut as aforesaid, and to be taken on your backs, and carried to the town of Whitby, and to be there before nine of the clock, the same day before mentioned; at the same hour of nine of the clock, if it be full sea, your labour and service shall cease: and, if low water, each of you shall set your stakes to the brim, each stake one yard from the other, and so yether them on each side with your yethers, and so stake on each side with your strout stowers, that they may stand three tides without removing by the force thereof: each of you shall do, make, and execute the said service and all that very hour, every year except it be full sea at that hour, but when it shall so fall out, this service shall cease. You shall faithfully do this, in remembrance that you did most cruelly slay me, and that you may the better call to God for mercy, repent unfeignedly of your sins, and do good works. The officer of Eskdale-side shall blow—Out on you, out on you, out on you, for this heinous crime. If you or your successors shall refuse this service, so long as it shall not be full sea at the aforesaid hour, you or yours shall forfeit your lands to the Abbot of Whitby, or his successors. This I entreat and earnestly beg that you may have your lives and goods preserved for this service: and I request of you to promise by your parts in heaven, that it shall be done by you and your successors as is aforesaid requested, and I will confirm it by the faith of an honest man." Then the Hermit said, "My soul longeth for the Lord; and I do as freely forgive these men my death, as Christ forgave the thieves on the cross." And in the presence of the Abbot and the rest, he said, moreover, these words, "*In manus tuas, Domine, commendo spiritum meum, a vinculis enim mortis redemisti me, Domine veritatis. Amen.*"\* So he yielded up the Ghost the eighth day of December, 1159, whose soul God have mercy upon. Amen.

\* O Lord, into thy hands do I commit my soul, for from the chains of death hast thou redeemed me, O Lord of truth!

## PROGRESS OF RAILWAY WORKS.

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*Birmingham Railway.*—The Primrose-hill tunnel, which was begun about two years since, was finished on the 26th ult.

*New Railway.*—We have heard that Mr. Currie, of Regent-street, has invented a new railway, which is to be of timber, and raised above the ground so as to be out of the reach of injury to persons or property, leaving underneath the lines free and uninterrupted intercourse, in perfect safety, for the inhabitants, as well as removing every obstruction to the progress of agricultural operations, thereby dispensing entirely with embankments, fence walls, &c.\* A very considerable saving from the capital now required for railways is besides expected to be effected. It is stated that he proposes, in establishing the new railway, to adopt certain trunk or main lines throughout the country, so arranged that three-fourths of the inland towns and western sea-ports may be within twelve miles of some one of the main lines, so that a great saving might be made by new railway companies by directing their branch lines, which may not exceed ten or fifteen miles, towards these main lines, instead of single towns or districts running separate lines to London. The whole to be upon a regular and uniform system, in perfect accordance and conformity with the main lines. If such a plan could be carried out there would be little doubt of its utility.

*Birmingham Railway.*—It is confidently expected that the whole line of the London and Birmingham Railway will be completed early in the summer of 1838. The communication between London Hemel Hemsted will be opened to the public on the 1st of June next, and will be continued as far as Tring before the close of the year.—*Times*.

*The Grand Junction Railway.*—This gigantic structure across the valley of the Weaver, near Dutton, in Cheshire, which is now near its completion, exceeds in magnitude any thing of the kind yet accomplished in this country, or perhaps in Europe, not even excepting the splendid bridge over the Menai Straits. The viaduct is of the Gothic order, formed of red stone, procured from the neighbourhood of Bolton and Runcorn; it consists of twenty arches, of sixty feet span, and sixty feet in height, and the battlement, when finished, will add twelve feet more to the height, and the whole length is 1,400 feet: 700,000 cubic feet of stone have been used in the work, and it will be completed in less than eighteen months from the time of its commencement, and at an expense of 50,000*l.*, being considerably under the estimate.—*Liverpool Mercury*.

*Commencement of the Newcastle and North Shields Railway.*—

\* The carriages to be as light as possible.

The foundation-stones of the Willington Dean Bridge, and the Ouseburn Bridge, on this line of railway, were laid yesterday, by John Hodgson Hinde, Esq. M.P., in the presence of the Directors, a large body of the shareholders, and a concourse of spectators. It had been arranged that the foundation-stone of the Willington Bridge, being in the county of Northumberland, should be laid by Matthew Bell, Esq., M.P., but severe indisposition prevented the Hon. Member from being present.—*Newcastle Journal*.

## RAILWAY NOTICES.

*Additional Post by the Greenwich Railway.*—A contract has, it is stated, been entered into between the General Post-Office and the London and Greenwich Railway, for the conveyance of an "additional" Post Office-bag; thus conferring on the borough of Greenwich the first-fruits of the new and rapid mode of communication by railways.—*Times*. City intelligence, 17th January. [This we think has long been done on the Manchester and Liverpool line.—E.D.]

*Railway from Bolton to Preston.*—Steps are taking towards forming a railway from Manchester to London. One also is contemplated from Bolton to Preston. The latter is to enable the goods for the bleachers to be conveyed with more speed than heretofore. Crossing the valley of the Ribble, will require an embankment of three miles long, one mile of which will need the removal of 2,000,000 cubic yards of earth, and with the bridge over the Ribble will cost more than £200,000.

*Brighton Railways.*—All the sections of the five contending lines to Brighton have been submitted to us for the purpose of computing their respective times of transit, powers, &c. Our time has not permitted us to go into more than two of them very carefully, Stevenson's and Mills's; but we have made some calculations on Rennie's and Gibbs's. The result of our investigations is, that in all the qualities which constitute a good and economical working line, Mr. Mills's is decidedly the best. That it will work easier, quicker, and carry a greater load than either of the other three named with it there can be no disputing. It has also an advantage, which neither of the others has, that of having no tunnels. The South-eastern line we have not been able to look into.

*Bristol and Exeter Railway.*—In making an excavation for the Bristol and Exeter Railway, near the city, the workmen have struck on a strata of slate, the specimens of which we thought highly of, and should the present anticipations be realized, the discovery will prove of immense advantage to Exeter and its neighbourhood.—*Exeter Flying Post*.

*Calcutta and Saugur Railway.*—We regret to learn that infor-

mation has been received at Lloyd's of the total loss in the river Hooghly of the valuable ship, the Windsor, 1,400 tons burthen, on her voyage from London to Bengal and China. The crew saved. The amount of insurances effected in London is stated at £100,000.—*Leeds Intelligence*.—Is not this a strong argument in favour of the Calcutta and Saugur Railway, by which the whole of this dangerous river will be avoided? Here is a ship and cargo of 100,000*l.* value, which, after encountering a voyage of 5,000 or 6,000 miles, is lost almost in the very port to which she is destined.

*The Commercial and Blackwall Railway*.—Yesterday, at a Court of Common Council, Mr. Heppel presented a petition from the Commercial Blackwall Railway Company, signed by the Chairman of the East and West India Dock Companies, and other respectable names. The railroad was to be carried on arches, and would not disturb the sewers, the streets, or the water or gas pipes. The petition was read, and prayed the corporation to give their sanction to the Bill for the continuation to Leadenhall-street. The petitioners were attended by Mr. Charles Pearson, their Parliamentary agent, who addressed the Court in support of the undertaking, and pointed out its convenience to the inhabitants of London. Clauses had been introduced into the Grand Junction Bill which effectually removed all danger, the locomotive engines on the road were required to work with wire gauge hoods to the orifice of the chimney, to prevent the escape of sparks, and similar protection against ignited matter from the ash-holes. The Company he represented went further; for, in addition, they intended to place the construction and working of the engines under the control of the Commissioners of Woods and Forests. Mr. Dixon asked if there would be any protection against the smoke of the engines? Mr. Pearson said there was a clause in the Bill forbidding the Company, under heavy penalties, from working any engine that did not consume its own smoke. (Hear, hear.) The petition was referred to a Committee. Petitions from the *Westminster and Greenwich Railway Company*, and the Eastern Counties Railway Company were also presented, and referred to the same Committee.—*Times*.

*Eastern Counties Railway*.—We have taken some pains to inquire into the true state of this company's difference with Lord Petre, Sir Edw. Kerrison, and Mr. Labouchere, and the sum of the information obtained is this. With respect to Lord Petre, he objected to the railway passing through his lands from the first, and determined to resist it by every means in his power; at the same time, observing to the company that there was a better line a little distance on one side, and he would desist if they would take that. To avoid so powerful an opposition the company executed bonds, binding themselves to pay him 100,000*l.* for the trespass or nuisance, and 20,000*l.* for the land taken, if they failed to apply

for a Bill in the following session (the present) of Parliament to make the deviations desired. On the faith of these bonds, Lord Petre withdrew his opposition, and the Bill passed for the line through his lands. Finding, however, it is said, that the company do not intend to make the deviations, nor pay the money, he has moved for, and obtained an injunction against them. The cases of Sir Edw. Kerrison and Mr. Labouehere are very similar.

*Gloucester and Bristol Railway.*—Two lines have been projected between these cities, one called the Coal Pit Heath Line, of which a portion is finished; and the other the Direct Line, to be made. We have seen a comparative statement of the main points of the two, and from that it would appear the advantages are much in favour of the Direct Line, both as to the goodness of the line and its length.

*Great Western Railway.*—A very malicious report has lately been circulating to the prejudice of this work. It has been asserted, on the pretended authority of a person just come from Bath, that a quicksand has been met with in the Box-hill tunnel, which has altogether stopped the works, and obliged the Company to go to Parliament for a deviation, and go a considerable way round. We have inquired into this, and find it totally unfounded, and that it is only another manœuvre of some jobbers to lower the shares, for the purpose of enabling them to purchase to furnish the shares they had sold, without having one in possession, for a given price, to be delivered by a given time.—Ed.

*Greenwich Railway.*—We have in our possession forty-two days' returns of this line, and though in the midst of winter, and so sharp as we have had it, the average returns on this unfinished line amount to very nearly five per cent. on the whole capital. What will they be in the summer, and when the line is extended to Greenwich? The Stock Exchange bears have been very busy again with this little railway. They have actually found out that the arches are beginning to give way. When people are disposed to tell an untruth, why not tell a bouncer at once? They should have said they had seen all the arches down together.—Ed.

*Kent and South-eastern Railways.*—We should be glad to hear that these companies had come to an arrangement. They followed our advice last year, privately given, and we hope they will attend to it this year, publicly given. We are sure it will be better for all parties. Let the South-eastern retain, unmolested, their Dover line, and the Kent pursue, unmolested, their line to Ramsgate. The two lines in this way may each do well, but if they go wasting their money in Parliamentary warfare, it will be worse for both. We have made the above observations without knowing what the feelings of either company are, and from the simple wish to forward the true interest of both if we can.—Ed.

*Limerick and Waterford Railway.*—A pamphlet has recently appeared, in which the advantages of this railway are set forth in

a speech by Mr. George Lewis Smith, in very brilliant colours. It would appear from this gentleman, and the testimony of Dr. Ryan, the Catholic Bishop, that this line will be of peculiarly great benefit to the places and surrounding country; and that from Mr. Smith's statement, that which will be most grateful of all to the shareholders is shown, namely, that it will pay well.

*Liverpool and Manchester Railway.*—The line of railway from the station in Lime-street, Liverpool, to that in Water-street, Manchester, has been measured by order of the Directors, within the last few days, and its length is ascertained to be thirty miles and three quarters and thirty-three yards.—*Manchester Guardian.*

*Locomotive Engines.*—These engines appear to be attracting considerable attention in Russia. A letter from St. Petersburg, dated the 21st of November, says:—"The first iron railroad in Russia was opened on the 18th. The travelling steam-engine, built by M. Hackworth of New Shildon, having got finished was prepared for the occasion, but was not permitted to commence until religiously consecrated. At eleven o'clock, a.m., a friar with his attendants made their appearance at the station from which the train was to start, bringing with them a table, three wax candles, a dish full of holy water, and a golden cross. After being clothed with their priestly garments, they began to chaunt, and the priests crossed themselves and various parts of the engine, then took the birch and threw the holy water on the engine and the crowd of spectators which had assembled to witness the scene. The chief priest then prayed that the Emperor and family might be preserved, and that the engine might be fortunate and do much good; this, after pronouncing the benediction, concluded the ceremony, which lasted about three quarters of an hour. The candles were then removed, and the engine commenced with a train of carriages, and proceeded from Paulowsk to Kowzmino and back, much to the satisfaction of the spectators, and the Grand Duke, who rode on the train during the journey. The Emperor's attention was attracted by the magnificent appearance of the iron horse. He, addressing himself in English, said, 'It is the finest I ever saw.' The Emperor appeared much gratified with the success which had attended their first attempt at this new mode of conveyance."

*New Anti-Mephitic Apparatus.*—A. M. Vasseur has submitted to the French Academy of Sciences an apparatus for the use of those who are obliged to encounter foul air, either in pits or wells, or at fires, and which he believes to be superior to all hitherto invented. Its advantages, he says, are, that the wearer can work the apparatus himself, that by listening at the external opening of the pipe, those without can immediately tell if any accident has happened to the person within, and it may be put on or thrown off in half a minute.—*Mining Journal.*

*Effects of the Steam Engine and Railroad.*—The steam-engine and the rail-road are not merely facilitating the conveyance of

merchandize from one part of the country to another—they are doing more—they are sealing the intercourse between mind and mind, and they are creating demands for knowledge—sending the desire for that knowledge into all the recesses of this empire, tending powerfully to the cultivation of the mental, as they are improving the physical capabilities of the country.—*Sir Robert Peel's Address at his Installation at Glasgow.—Herald.*

*London and Croydon Railway*—A Special General Meeting of the Proprietors of this company took place on the 11th Jan., John Moxon, Esq., in the chair. The object was to declare the forfeiture of certain shares upon which the calls had not been paid, when the chairman stated that he had the pleasure to announce that the call on the shares had all been paid, so that there are no shares in a condition to be forfeited. Several questions were asked of the engineer as to the progress of the works. The answers to which appeared to be quite satisfactory to the meeting.

*Newcastle, Edinburgh, and Glasgow Railway.*—We have often noticed the immense advantages that the inhabitants of Glasgow would derive by the formation of a railway running through the rich mineral districts of Lanarkshire. The present high price of coals, has, we are glad to learn, given a decided stimulus to an undertaking that will have this desirable object,—we allude to the Newcastle, Edinburgh, and Glasgow Railway. The quantity of coal of the best quality that is shut out of the Glasgow market in consequence of the want of a railway, is sufficient to supply Glasgow for some centuries.—*Glasgow Chronicle.*

*Newcastle-upon-Tyne, Edinburgh, and Glasgow Railway.*—(*From the Kelso Chronicle.*)—The importance of a railway communication betwixt Newcastle-upon-Tyne and our Scottish metropolis, and the great commercial and manufacturing city of Glasgow, has, our readers are aware, for some time occupied public attention; and the exertions of Mr. Richardson, civil engineer, of Newcastle, to carry this object into effect, and his indefatigable perseverance, have been rewarded by the flattering state of the subscription.

*Preston and Wyre Railway and Harbour.*—We have read Captain Belcher's Report to the Lords of the Admiralty, as to the present state of the harbour of Wyre, and the facilities of making it a harbour of refuge. It is well drawn up, and Captain Belcher's suggestions of improvements, which we are informed have been to some extent anticipated by the Railway and Harbour Company, and are now progressing, appear very judicious. The company have reason to congratulate themselves upon such valuable and official testimony in support of their undertaking. The Report itself is too long for insertion here, but the effect is, that the proposed alterations, which are trivial in point of expense, would make it a complete port; and that, by erecting a pier on banks, which at present act as a breakwater to the channel, Wyre would afford all that is required for a harbour of refuge, viz., an easy access at all times of the tide, and particularly at dead low water at spring



tide. The following extract from the report appears to be very important to those embarked in this undertaking, and to the shipping interest generally in Lancashire, where the rivers are proverbially dangerous.

Captain Belcher, after describing the *trivial* alterations required to make it a complete port, states thus:—"The Wyre would then offer one fair long leading mark from sea, entirely independent of buoys, be totally independent of pilots, and a moderate proportion of intelligence would only be required from the masters of vessels seeking shelter therein."

We are informed that Mr. George Stephenson, the engineer, has lately visited the harbour and line of country of the railway, and speaks highly of the undertaking and its great capabilities.

*Plans and Sections Deposited.*—Out of the 118 notices for Bills and alterations, mentioned in our last, 99 only have been deposited at the offices of the clerks of Parliament, agreeable to the standing orders, which ought to be on or before the 30th of December. Probably excuses will be made, and permitted, for some of the lagging ones, on account of the state of the roads at the last days.

*Railroad Mania.*—The gentlemen of the long robe are looking forward to a plentiful harvest during the ensuing session, in advocating and opposing the various railway projects now in contemplation, to complete which would require a capital of forty millions.—*Morning Herald.*

*Railway Travelling by Wind.*—So violent was the wind on Monday last, that the Union Railway coach, between Stockton and Middleborough, was blown from her station all the way to Stockton (four miles) in fifteen minutes.—*York Courant.*

*Right of Way across Railways.*—A question of importance to railway companies, and to the owners of property through which they pass, was decided yesterday by the magistrates, at the Brentford petty sessions. Mr. Edward Morse, the owner of considerable property at Drayton Green, Ealing, through which the Great Western Railway passes, had applied, through his solicitor, to the magistrates, for an order compelling the company to give Mr. Morse a right of way across the railroad, by the erection of gates, by means of which he might pass across the railroad from one portion of his property to the other, instead of making a circuitous road for the purpose. The magistrates decided in favour of Mr. Morse; and as many of the railway Acts contain clauses giving similar powers to magistrates, the decision is of general importance.—*Globe.*—[The magistrates in this case were very silly, and Mr. Morse more so. Is it fit that a great highway (for such a railway is), for the whim of one individual, should be interrupted, and put the man's life in jeopardy too?—ED.]

*South Midland Railway.*—A Public Meeting was held in Northampton, on Monday week, to petition the Legislature in behalf of the South Midland Railway Bill. Mr. Giles, the engineer

of the company, attended, and stated "that the main line was as nearly straight as the nature of the country would admit; that the gradients were well adapted for the useful and economical working of locomotive power; that the only construction in the shape of a tunnel, would be an archway about a quarter of a mile in length, the transit through which would occupy little more than half a minute; and that the most scrupulous caution had been used, occasionally to the sacrifice of the integrity of the line, to avoid residence property; and not to trench upon the exclusive tastes of any landowner." In speaking of the inclinations, Mr. Giles said, "that those from Northampton, a distance of  $4\frac{1}{2}$  miles, about which so much misrepresentation had prevailed, were 20 feet in a mile; whilst on the Manchester and Liverpool Line, some of the planes were equal to 55 and 60 feet in a mile; and upon these, locomotive engines worked with comparative facility."

*South-western and London, Salisbury, and Falmouth Railways.*

—A negotiation, which has for some days been going on to unite the two companies, has terminated in nothing.

*South Union Railway.*—On Tuesday last a deputation consisting of forty gentlemen, with Mr. Fleet as their chairman, waited, on the part of the committee formed in this town for the purpose of co-operating with the South Union Railway Company in obtaining a main line of railway passing through Macclesfield, on E. J. Stanley, Esq., at the Macclesfield Arms Hotel, for the purpose of thanking him for the good offices he had performed to the South Union Railway Company during the last session of Parliament, and of soliciting his future support to the Bill of that company, when introduced next session to the House of Commons. Mr. Stanley expressed himself highly gratified at finding that his former conduct on this question had given satisfaction to so many respectable gentlemen as formed the deputation. He assured them that he should ever endeavour to show himself alive to the interests of Macclesfield. With respect to the future proceedings on the intended South Union Railway Bill, he could not, without having seen the two plans, pledge himself at present to give his support to either. Thus much, however, he would say, that line should have his support, which should, in his opinion, be the best calculated to further the interests of the bulk of his constituents. He had been informed that the South Union Line was that which was preferable in this point of view. If on examination it should prove so, he assured the deputation that he should have great pleasure in giving it his most cordial support. The deputation then withdrew. The answer of Mr. Stanley was considered to be very satisfactory, and the deputation expressed themselves highly pleased with the frank and courteous reception which they had met with.—*Macclesfield Courier*, Jan. 14.

*Southampton Railway.*—A change has taken place in the engineering department of this line. Mr. Giles, the original

engineer, has had his lease run out, and Mr. Locke has succeeded as tenant at will.

*The Thames Haven Company*, we perceive by our advertisements, have made a call of 2*l.* 10*s.* per share, and we understand, intend forthwith to commence the works at the dock, the land having been purchased some time since. This looks like business.

*Whitby and Pickering Railway*.—The roads in this neighbourhood from the heavy falls of snow during the last week have been rendered impassable for the coaches running to Gainsborough and Scarborough. The mail cart from Pickering has also been delayed three or four hours behind its usual time, and all communication to and from Whitby with the neighbouring districts except by the railroad to Pickering has been cut off. The coaches belonging to the company have been running during the week and continue to do so at the stated times, and have not hitherto been delayed more than an hour in performing the distance between Whitby and Pickering. Hence a great convenience arises to the public, in keeping open the means of conveyance, as persons engaged in business are thus enabled without delay to proceed to and from Whitby to Pickering, and thence to York, Leeds, Manchester, Liverpool, &c., and a decided proof, in the safety and dispatch, with which passengers are conveyed even in winter, is also thus afforded of the superiority of railroads over any other mode of conveyance.—*Leeds Intelligencer*, Dec. 31.

We have received a book written by Mr. Henry Belcher, entitled, "Illustrations of the Scenery of the Whitby and Pickering Railway," containing several well executed plates of different scenes on this line. We have frequently heard of the varied and delightful scenery on the Whitby and Pickering Railway; but Mr. Belcher's book almost tempts us to go and see it.

## FOREIGN RAILWAYS.

*Russian Railroad*.—The large locomotion of Messrs. Robert Stephenson, and Co., of Newcastle, first commenced running on the 28th of November, from Pawlowsk to Kusmino, and back a distance of fourteen wersts. The inauguration of the engine took place on the 29th of November, during a violent snow-storm, in the presence of thousands of spectators, many attracted by the doubt of its being able to start at all, after so heavy a fall,—no sooner, however, had the brush machine been let down upon the rails, and the steam set on, than the train, consisting of eight carriages and 256 passengers set off, clearing the distance there and back at the rate of three, two, and even one minute to the werst.

The fares were eighty copecks first class, and forty the second.

To show the public that the requisite fuel to drive the engines was in the country, nothing but birch wood was used for firing, although coal and coke will be employed in future. The consumption of birch wood may be estimated at one fathom per twenty-five and a half wersts, the distance between St. Petersburg and Pawlowsk, making, at ten rs., the cost of fuel only twelve and a half copecks each passenger.

The traffic has hitherto been confined to the inhabitants of Pawlowsk and Zarkoe-Selo, the road from Petersburg being impassable.

Many families are about to remove from Petersburg to these places as soon as the railroad is finished.

As a singular circumstance it may be mentioned, that among the passengers, the number of which was 654 first class, and 754 second class, equal to 1406 the first four days, there were between 500 and 600 peasants and carriers, a class of persons expected to be the most prejudiced.

The embankment between St. Petersburg and Pawlowsk contains 902,000 cubic yards of earthwork, and is in some places 20 to 28 feet high.

*Russian Railroad.*—The third line is that from Moscow to Colomna, and is a very favourite speculation at Moscow. The survey and levelling of it has already commenced. By the official accounts, the quantity of grain, provisions, merchandize, and goods of all kinds passing between these two places riverwise, amounts to upwards of 150,000 tons, and 50,000 tons more by land. The number of passengers is very considerable, as Riasan, Sazatoff, Tamboff, Woronesh, and Taganrog, all stand in connexion with this line.

The distance by land from Moscow to Colomna is ninety-six wersts, taking in its line three towns and twenty-three populous places. Four wersts below Colomna the Moskwa falls into the Oka; but the river winds full 160 wersts, and boats and craft take frequently from two to six weeks, and even three months, to reach their destination; whereas, as by the railway, the line of which is highly favourable, the thirteen German miles will occupy but a few hours.

*Railroads in Cuba.*—A few days since a great crowd of persons collected in the New Road, to witness the progress of a vehicle drawn by twelve horses, on which was a steam-engine, constructed for the Island of Cuba, where a railroad is in the course of formation across the island seventy-five miles in length. The weight of the machine is about nine tons, and costs 1,450*l*. It possesses a thirty horse power; and on Thursday it was tried on the Birmingham and London Railway, when, at a speed of twenty-five miles an hour, it drew sixty tons weight, which was contained in nineteen carts filled with gravel.—*Standard*.

# PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on												
					Dec.	January.											
					30.	3.	6.	10.	13.	17.	20.	24.	27.				
9,500	.....	(3) Birmingham and Derby .....	£.	£.	7½	8½	8¼										
7,500	.....	(3) Birmingham and Gloucester .....	.....	10	.....	9¼	.....	.....	.....	9							
	.....	(3) Birmingham, Bristol, and Thames Junction .....	20	1	.....												
15,000	.....	(3) Bristol and Exeter .....	100	5	.....	3½	.....	.....	.....	.....	3						
660	.....	Calcutta and Saugur .....	50	2													
350	.....	Cheltenham .....	100														
7,500	.....	(3) Cheltenham and Great Western .....	100	7½													
14,000	.....	(4) Cheltenham, Oxford, and Tring .....	100	5	.....	.....	.....	.....	3½	.....	.....	.....	2½				
2,000	.....	(2) Clarence .....	100	100	.....	.....	.....	.....	.....	.....	.....	.....	.....				
12,000	.....	(3) Commercial Blackwall .....	50	2	.....	.....	1½	.....	.....	3	3	.....	2¾				
8,000	.....	(4) Dublin and Kilkenny .....	100	2½	.....	2½	2½	.....	2½	3	3	.....	.....				
7,500	.....	(4) Durham South-West Junction .....	20	3	.....	.....	.....	.....	.....	.....	.....	.....	.....				
60,000	.....	(3) Durham Junction .....	100	10	.....	.....	1¾	1¾	1¾	.....	1¾	.....	.....				
	.....	(3) Eastern Counties .....	25	2	.....	1½	1½	.....	1½	.....	.....	.....	.....				
5,000	.....	Edinburgh and Dunbar .....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....				
13,000	.....	(3) Edinburgh, Leith, and Newhaven .....	20	1	.....	.....	.....	.....	.....	.....	.....	.....	.....				
800	.....	(4) Edinburgh and Glasgow .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....				

2,800	.....	(4)	Glasgow and Falkirk Junction ...	50	3	43	48½	46	48½	46	43	44	43		
25,000	.....	(2)	Grand Junction .....	100	50										
2,000	.....	(3)	Great North .....	.....	2										
11,000	.....	(2)	Great Western .....	100	30	43	48½	46	48½	46	43	44	43		
8,000	.....	(2)	Hartlepool .....	100	100										
40,000	.....	(4)	Harwich .....	20	1										
2,100	.....	(2)	Hull and Selby .....	50	5										
1,500	.....		Kent .....	50	2										
5,100	.....	(1)	Leeds and Selby .....	100	100										
	.....	(1)	Leicester and Swanton .....	50	50										
	.....	(1)	Liverpool and Manchester .....	100	100										
	.....		Ditto, ¼ shares .....	25	25										
10,000	.....	(4)	London and Brighton (Stevenson's)	100	5	8	8½	.....	.....	8½	8½	8½	8	7½	
45,000	.....	(4)	— (Gibbs) .....	20	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	
16,000	.....	(4)	— (Rennie) .....	50	3	.....	17	17	17	17	17	17	17	2	17
8,000	.....	(4)	— (Cundy) .....	100	3	.....	2	.....	.....	2½	2½	.....	.....	17	17
12,000	.....		London and Blackwall .....	50	3	.....	.....	.....	.....	1½	.....	.....	.....	.....	
20,000	.....	(2)	London and Greenwich .....	20	20	20	21½	21½	21½	21	20	20	20	20	100
	.....		Ditto, Bonds.	.....	.....	.....	.....	.....	.....	100	.....	.....	.....	.....	
25,000	.....	(2)	London and Birmingham .....	100	75	139	145	140	140	141	146	145	145	.....	
	.....		Ditto, Bonds, 1834.	.....	.....	.....	25	.....	.....	22½	22	22½	22	20½	
20,000	.....	(2)	London and Southampton .....	50	30	.....	.....	.....	24	22½	22	22½	22	20½	
7,000	.....	(3)	London and Croydon .....	20	13	.....	.....	.....	.....	.....	.....	9½	9½	.....	
12,000	.....	(3)	London Grand Junction .....	50	2	1½	4	5	.....	.....	.....	.....	.....	.....	
10,000	.....	(3)	Manchester and Leeds .....	100	5	12	14	.....	12½	.....	.....	12	.....	.....	
1,000	.....	(4)	Manchester and Oldham .....	100	3	4½	4½	.....	.....	.....	.....	.....	.....	.....	
10,000	.....	(4)	Manchester South Union .....	100	5	4½	4½	.....	.....	3½	6½	6½	6½	6½	

# PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on											
					Dec.		January									
					30.		3.	6.	10.	13.	17.	20.	24.	27.		
15,000	.....	(3) Midland Counties .....	£. 50	5	15 $\frac{1}{2}$	17	16 $\frac{1}{4}$	.....	.....	15 $\frac{1}{8}$	15 $\frac{3}{4}$	.....	.....	.....	.....	.....
2,500	.....	(3) North Midland .....	100	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,600	.....	(3) Northern and Eastern .....	100	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4,000	.....	(2) Preston and Wigan .....	.....	20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1,000	.....	(2) Preston and Wyre .....	50	18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1,500	.....	(3) Sheffield and Rotherham .....	25	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3,000	.....	(1) Stockton and Darlington .....	100	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28,000	.....	(2) Stanhope and Tyne .....	100	21 $\frac{1}{2}$	28 $\frac{1}{2}$	28 $\frac{1}{2}$	27 $\frac{1}{2}$	.....	.....	2	1 $\frac{1}{2}$	1 $\frac{1}{2}$	6 $\frac{1}{2}$	6	.....	.....
24,000	.....	(4) South Durham .....	50	7	28 $\frac{1}{2}$	28 $\frac{1}{2}$	3	.....	3	2 $\frac{1}{2}$	2 $\frac{1}{2}$	2 $\frac{1}{2}$	2	2 $\frac{1}{2}$	.....	.....
40,000	.....	(3) South-Eastern and Dover .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9,000	.....	(4) Do. Brighton, Lewes, and Newhaven .....	50	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6,600	.....	(4) South Midland .....	50	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6,000	.....	(4) South-Western (Stevenson's) .....	50	21 $\frac{1}{2}$	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	(3) Thames Haven .....	25	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	(4) Victoria .....	50	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	(3) York and North Midland .....	50	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of  $\frac{1}{4}$  in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

# THE RAILWAY MAGAZINE;

AND

*Annals of Science.*

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No. XIII.

MARCH, 1837.

NEW SERIES.

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*On some Points connected with the Principles of Locomotion, Assistant Engines, &c.* BY THE EDITOR.

In the preceding numbers of this Magazine, I have endeavoured to elucidate the theory of locomotives, and of railway transit, and, as far I could, to render it accessible to the commonest capacities. If these understand it, we are quite sure those of a higher order easily can. From the very nature of the subject, however, I have been obliged to have recourse occasionally to mathematical investigations, but I have uniformly endeavoured, as much as possible, to suppress them, well knowing that nothing is more repulsive, even to mathematical readers, than long symbolic processes and intricate formulæ. There is an old military maxim, that it is much easier to beat our enemy in detail, than to encounter his whole force at once. I have endeavoured to profit by this old saw, and by taking up the subject, piece by piece, each piece being however complete in itself, to surmount the obstacles, one by one, instead of facing them all at once. By this means, I have been enabled to give the theorems in a much simpler form, with scarcely any sacrifice of accuracy. I am, however, fully satisfied that many of these theorems, and indeed any that have yet been given, are only good approximations. Certain considerations in my own, which may have tended to greater mathematical precision, have been designedly omitted, either because they would too much clog the formulæ, or because it appeared to me we should affect greater accuracy than our present knowledge would justify. It is very often, on this account, that our theorems have so much advantage over M. Pambour's, in point of simplicity, while, as I have shown, the results are very nearly the same.

Speaking of the formulæ, I embrace the present opportunity of supplying an omission in the theorems for the



generation of velocities (9) p. 251, and (10) p. 403. Each of these theorems giving the value of  $ax$ , is the sum of two separate integrals following different laws, and the expressions are therefore what are called discontinuous functions. For instance, the value of  $aX$  is deduced from a constant force, the bite of the wheels, and operates in the value of  $ax$  as the constant of integration, in all cases in which  $v$  exceeds  $cV$ . Previous to that it is  $a$  variable, and the value of  $v - cV$ , or all the terms except  $\frac{c^2 V^2}{2(1 - pc)}$ , have no ex-

istence. So that before this point,  $ax$  is simply  $\frac{c^2 v^2}{2(1 - pc)}$ . This it is needful strictly to bear in mind, as otherwise the general theorem, in all cases where  $v$  is less than  $cV$ , will give incorrect results. It was an oversight that this case had not been mentioned when the theorems were given.

As I am on the subject of omissions, I must take the liberty of alluding to another which has been hinted to me. It will be seen in the theory of locomotives which I have laid down, that I have not noticed "the resistance of the air to the motion of the piston," which Pambour and some others—one of the correspondents in our present Number, I perceive—lay at a uniform value of 15lbs. to the inch. Some of my friends have therefore supposed that this element had escaped my notice, and have in kindness reminded me of it. Fully sensible of my own liability to err, I am always thankful for any corrections so kindly communicated, whether true or not. In the present instance, however, they are unnecessary to truth, but quite so for the purpose of reminding me, that I have never given one word of explanation why I have passed over a point apparently of so much importance, and which, if true, particularly to the extent assumed by others, would vitiate many of the theorems I have given.

The simple reasons are these. It is pretty generally known, from a series of letters that appeared in the "Times" paper, during the years 1826, 1827, and part of 1828, which ended in the expulsion of the tool of my opponents, Sir H. Davy, from the Presidency of the Royal Society, that I am in possession of discoveries respecting the principles and laws of Natural Philosophy, that have enabled me to solve problems hitherto defying the utmost efforts of the scientific world, but which principles, &c., owing to the treatment I experienced, have never been published, with the exception of a few detached portions.

These discoveries I have naturally applied to overcome many difficulties in the theory of locomotion; but to save myself trouble, have not always alluded to them. The case in question is an instance. In fact, the resistance of an air to an air, follows a very different law to that of a solid body or surface to an air; and in the case of a piston the law is such, that it is nearly the same, as far as regards the way in which I have considered it, whether the piston has steam or a vacuum on the advancing side of it; and therefore no sensible error arises from considering it a vacuum.

I am unable at present to go any farther into this matter; but should any of my readers have taken the same view of my silence, which the friends alluded to have, this explanation will, I hope, satisfy them.

I think it but candid here to observe, that I do not imagine any one is in possession of a rigidly mathematical theory of locomotion. I will go farther, and say I do not think, with the principles received, any one can give such a theory. All that we have yet done is only, to say the best of it, good approximation; some of course is much better than others. May I be permitted to hope that the theorems given in this Magazine will be found to exceed others as much in accuracy, as I believe it is obvious to every one they do in simplicity? To perfect the theory of locomotion, we are sadly in want of experiments. Mr. Wood and M. Pambour have done great good by their experiments; and I have been indebted much to both for materials in my investigations, but still we are lamentably deficient. Some time back my friend Col. Landmann very kindly offered me the use of the Greenwich engines and line for making any experiments I wished. There is, however, hardly length and variety enough of gradient on that line to carry on extended experiments. I am therefore anxiously waiting to see some considerable length of the Great Western, Birmingham, Southampton, and Northern and Eastern lines completed; and from the known liberality of the directors of these companies, I have no doubt much good may be done.

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*An engine of a given weight having a given load to take up an incline, it is required to find the weight of an assistant engine, in all respects similar and proportional in power, sufficient to carry the load up the incline.*

If we suppose  $L$  the weight of the whole mass exclusive of the engine,  $E$  the weight of the engine which

we suppose has coupled wheels,  $b$  the bite of the wheels, or amount of slipping friction,  $t$  the tractive force, and  $p = 1 + \frac{h}{19}$  the force of the traction on the incline,  $h$  being the rise of the plane is feet per mile. Then is

$$tp(L+E)$$

the force of traction of the entire mass including the engine. But the greatest force the engine can exert, is equal to  $bE$  the amount of its bite or slipping friction. If, therefore, the former force exceeds this, it is evident the engine cannot continue to ascend the hill after the impetus is lost; but it would begin to descend by the whole excess

$$tp(L+E) - bE.$$

Adding to this the tractive force of the auxiliary engine, the sum will be the duty this auxiliary engine has to perform. Consequently, if  $e$  denote the weight of the auxiliary engine, the equation

$$tp(L+E) - bE + tpe = be$$

will give the least weight the auxiliary can be of, to help the load up the hill.

$$\text{Hence } e = \frac{tpL}{b - tp} - E \quad . \quad . \quad . \quad (1)$$

Now according to experiments  $t = \frac{1}{280}$ , and  $b = \frac{1}{10}$ ; so that restoring the value of  $p$  and substituting these numbers for their symbols, we shall have

$$e = \frac{19 + h}{513 - h} L - E.$$

It immediately strikes us in this last expression, that the fraction becomes infinite when  $h = 513$ ; that is, that a plane rising 513 feet to the mile would require an infinite weight in the auxiliary engine to take up the load. At such an inclination indeed the bite of the engine would be barely able to maintain it on the plane; and prevent it from sliding down by the power of its own gravity.

Now, if we had any relation between  $L$  and  $E$  on a level, we could give  $e$  at once in numbers, for all practical ascents. The relation between  $L$  and  $E$  however will depend on the goodness of the engine in its evaporating power. An engine greater than the 28th part of the whole mass's weight, could maintain any velocity on a level provided it would generate steam sufficient. No relation, therefore, can be fixed between  $L$  and  $E$ ; but the limits are between that of 1 to 28 and 1 to 1.

If we take the celebrated experiment with the Sampson

Engine, made by Stephenson, we may get a relation for all similar engines. By this experiment the Sampson took 223 tons exclusive of itself, 9 tons 17 cwt. and tender, at the average speed of 12 miles an hour from Liverpool to Manchester, with barely being helped up the Whiston incline. No doubt this was not a maximum effort, and that the engine would have done more. The gross load was however here about 237 tons, and if we suppose about 50 square feet of surface were exposed to the atmosphere, the total load was about 240 tons. A similar engine, therefore, of 10 tons would take a load of 97.6 tons 30 miles an hour on a level, or, as the wheels of the Sampson were coupled,  $9\frac{3}{4}$  the weight on the working wheels. If we suppose a little more heating surface to be given to the boiler, this  $9\frac{3}{4}$  may be made 10, or by a little less it may be made 9, to accommodate any other point the case of calculation requires.

Putting  $L = 100$  and  $E = 10$ , we get

$$e = \frac{11h - 323}{513 - h} 10$$

So that  $11h$  must be greater than 323, or  $h$  greater than about  $29\frac{1}{3}$ , or the expression will be negative; that is any incline not exceeding  $29\frac{1}{3}$  feet per mile would not need an assistant engine to help one of 10 tons to take up a gross load of 100 tons. If  $h = 60$  the assistant engine cannot be less than  $7.4$  or  $7\frac{1}{2}$  tons.

*Given the velocity with which an engine of a given weight can take a given load along a level, to find the velocity with which that and a like and similar assistant engine joined with it can take the said load up a given incline.*

If an engine takes a given load along, and you ask an engineer what force you must put on to take with the same velocity the same load up an incline which just doubles the traction, he will generally answer twice the force or two such engines. On this principle are most of their calculations made. Now, such would be true, if the additive engine possessed all its power with none of its weight. But the engine has not merely to contribute its share to draw the original load, but likewise the weight of itself; which in the present instance is also doubled. It is evident, therefore, that instead of the two engines taking the original load at the same speed up the incline, they could only take a load equal to the original, minus the weight of one of the engines.

I do not here take into account, neither have I in any of the theorems, the greater friction of the engine. With any

thing of a load this is but a small part of the whole, and is proportional to the work the engine has to perform, and therefore to the load. My reasons for having neglected it are the extreme uncertainty in which, from the experiments of Pambour, valuable as they are, its actual quantity is involved, and from my having used a rather greater amount of friction than the latest and best experiments seem to justify. Should any one however wish to include it, he may augment the gross weight of the total mass, by about 50, 60, or 70 per cent. of the weight of the engine, or of the weight on the working wheels; but then I apprehend he must diminish the traction from  $\frac{1}{280}$  to  $\frac{1}{300}$ , which will bring him back to very nearly the same point.

Let  $L$  be the total mass exclusive of the engine, and  $E$ ,  $p$ ,  $h$  represent the same things as before, and  $\mathbf{E}$  the weight of the engine drawing the total load or mass  $\mathbf{L}$  on a level, at the velocity  $V$ . Then by principles demonstrated in No. 6, pp. 201, &c., if the whole mass and engine be altered, the velocity will be as the old mass directly, and the new mass inversely, and as the new engine directly, and the old one inversely, supposing them similar and proportional in power and weight. And the velocity on a level is by the same principles to the velocity on an incline, with the same engine and load, as  $p$  to 1. Therefore

$$v = \frac{\mathbf{L} E V}{p \mathbf{E} (L + E)} \quad \dots \quad (2)$$

Hence the following:

**PRACTICAL RULE.**—*Multiply the total mass ( $\mathbf{L}$ ) an engine would take on a level by the velocity ( $V$ ) at which it would take it, and then by the sum ( $E$ ) of the weights of that engine and the assistant engine. Then multiply the whole mass ( $L + E$ ) increased by the weight of the assistant engine, by the weight ( $\mathbf{E}$ ) of the principal engine, and then by the sum ( $p$ ) of unity and the quotient of the inclination per mile divided by 19. Dividing the first found product by this, will give the velocity sought.*

**EXAMPLE.**—Let us suppose, as in the former case, an engine of 10 tons would take a load including itself of 100 tons on a level the rate of 30 miles an hour, at what rate would an assistant engine of 12 tons added to it of similar construction and proportional power, take the load up the Sutton incline, rising, suppose 57 feet a mile? It rises more than this, but we take 57 because it is divisible by 19. Therefore,  $100 \times 22 \times 30 = 66,000$ , and  $1120 \times 10 \times 4$

=4480 ; and dividing 66000 by 4480 gives 14·7 the velocity with which the two engines would take the load of 90 tons up the incline.

*Public Works.* Communicated by CHARLES VIGNOLES, Esq., C.E. & F.R.A.S., &c. &c.

TABLE of the average number of working days in the year, and also the number of hours which may generally be worked through each day, calculated from returns and observations made during a series of many years' practical experience—chiefly applicable to Ireland, Scotland, and the north of England ; and for Railway, Canal, or Road Constructions, or similar Public Works :—

	Days.	Working Hours.	Or Hours per Month.
January ...	14 .....	7 .....	98
February ..	12 .....	7 .....	84
March .....	18 .....	8½ .....	153
April .....	20 .....	12 .....	240
May .....	24 .....	16 .....	384
June .....	20 .....	21 .....	420
July .....	22 .....	21 .....	441
August ....	20 .....	16 .....	320
September	20 .....	11 .....	220
October ...	18 .....	10 .....	180
November	16 .....	8 .....	128
December	16 .....	7 .....	112

220 Days for working in one year, or 2,780 Hours.

And by working 1½ hour extra per day in April—and making two 9 hour shifts in May and August, and 12 hour shifts in June and July say,—under this most favourable circumstances—3,000 working hours per annum.

[The above table, coming as it does from a man of Mr. Vignoles's standing, in his profession, will be peculiarly valuable at this time, now that we are going to have the matter canvassed over and over in Parliament. It appears to us remarkable, that May should be so fertile in working days, as to furnish four more than either of its immediate neighbours. We should like to know the reason of it. Perhaps some of our meteorological readers can furnish it.]—EDITOR.

*Estimate of Time occupied in the Execution of Earth-work,  
with special reference to the Formation of Railroads.* By  
WILLIAM TAIT, Esq., C.E.

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TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—Much diversity of opinion exists respecting an apparently very simple operation,—the *time* required for the execution of earth-work in cuttings, and the formation of embankments for railroads. One civil engineer of some celebrity in the construction of railroads, has stated that 150,000 cubic yards, in a year, is the usual quantity of earth-work which can be teamed at one end; he says, that he has known 180,000 yards done, but that was with great efforts; and he thinks it barely possible that 200,000 yards might be done, with very extraordinary exertions; another engineer gives 250,000 cubic yards, as the annual quantity to be teamed at one end; while a third states, that he believes 500,000 cubic yards *might* be done!!! As Mr. O'Connell says, "*This beats Bannagher.*"

This reminds me of an anecdote. About the year 1826 estimates were sent in for covering one side of a church, in the county of Herts, with Roman cement. One of these, it was said, amounted to 1,250*l.*, another to 1,150*l.*, another to 650*l.*, and the last estimate to 330*l.* The 330*l.* offer was accepted; *and the work was well executed.* I am sorry to say that we do not appear to have *progressed* much in accuracy since that time!

It occurs to me, however, that the mere matter of estimating the *time*, in which ordinary earth-work may be executed, cannot after all be involved in any very great mystery. I may be wrong in this supposition: but there can be no great harm in looking into it coolly and methodically.

An embankment may be executed in many different ways: by having leads from only one direction; or from both ends of it. Besides which, it may also have divers lateral leads to it from side cuttings, varying, in number, according to the topographical nature of the ground; and this may be the case to such an extent that, without being informed of all the circumstances, it would be impossible to form any estimate or opinion whatever of the probable time of executing such a work. The consideration then of an embankment of this rare kind, being somewhat foreign to

our present inquiry, we shall therefore suppose a very common case—an every day occurrence—viz. that a hill stands in our line, through which, *nolens volens*, we must cut our railway, forming, with the stuff so excavated from it, an embankment, at one, or both sides of the hill, at each end of the cutting; that the cuttings shall be so arranged as that, in their sectional areas, they shall be adequate to the formation of these embankments; and that we are enabled to run as much earth on to them as we can manage to *excavate*, at either extremity of the trench. We shall suppose, in fact, what frequently happens to be the case, that from the nature of the soil, and confined situation of the place, &c., there is every bit as much difficulty attending the EXCAVATION, and clearing away of the excavated stuff, as in the formation of the embankments. Let the average depth of our supposed trench, = 64 feet; the breadth of road may be 40 feet; and the slopes 2 to 1, which will give a total average width, at top, of 296 feet. Let us suppose that, from local circumstances and other causes, none of the stuff can be carried off, to spoil, in a lateral direction; but that all of it must, of necessity, be cleared off by leads, *in its longitudinal direction*. Let us suppose also that this is what is termed the *characteristic* earth work on our line of railroad, the soil being, at the same time, exceedingly favourable to work in.

It is well known to practical men that labourers should not be placed nearer to each other than 4 feet. Some have talked of 3 feet—but this won't do. Then the width of this profile, at half its depth, being 168 feet, which, at 4 feet apart, will just allow room for 42 labourers or excavators; and if we work in 3 tiers, or in 3 benches, at one time, it will give us 126, as the average number of workmen for this profile throughout from top to bottom. In making this calculation, it will be observed that no deduction has been made for *runs* or leads, to carry off the excavated earth, a matter which, in strict justice, ought certainly to be taken into account. But we shall waive this item for the present. It is quite evident, therefore, that, in such a profile, 126 workmen or excavators, is the very utmost number that can possibly be employed, at one time, on an average, *in the process of* EXCAVATION. We have nothing to do with the other labourers who may be employed to pitch the excavated stuff into the waggons, or from one place to another, or with any ulterior disposal of it whatever. All we are concerned



with at present is the mere quantity of matter which can be EXCAVATED in a given time.

Having determined the number of labourers, we must now endeavour to ascertain what quantity of earth, of ordinary earth, or easily wrought ferruginous sand, each labourer can dig in the course of a day. It is generally allowed that, in a summer's day, a labourer can excavate, in ordinary and favourable soils, 5 cart loads, or 5 cubic yards of earth. In the trenches, during a siege, it is well known that a soldier, *while under fire*, will, in order to get quickly under cover, excavate fully  $1\frac{1}{2}$ , or 1.55 cubic yards, in 3 hours (*but he is relieved every 3 hours*), which, in 12 hours, would be equal to 6.20 cubic yards. This is too much for civil practice, and so is twelve hours a-day. No labourer can work 12 hours a-day, even in summer, exclusive of meals. To make allowance for bad weather, and the difference of a summer and winter day, we may therefore reckon the working year as equal to only 250 days; and that in each of those days, each of our 126 labourers can excavate 5 cubic yards. By this supposition, we shall have only 155,500 cubic yards, excavated in a twelvemonth. But if we go so far as to suppose that, which is not very often the case, that a day-labourer is capable of excavating 6 cubic yards a-day, in a very favourable soil, we shall, in that case, have 189,000 cubic yards excavated in a year by 126 labourers. Let us call the quantity, in round numbers, 190,000 cubic yards. Now if it shall so happen that the total cubical contents of the *characteristic earth-work* on our line of railway shall amount to 1,733,760 cubic yards, we have  $\frac{1,733,760}{190,000} = 9\frac{1}{3}$  fully; that is, 9 years and 6 weeks would be occupied in the excavation alone, *if teamed from one end*; but, *if teamed from both extremities*, then the time occupied in the excavation of our supposed characteristic earth-work would be 4 years 6 months and 3 weeks. The time for settling and ballasting has not of course been taken into account here.

If the above profile were supposed to be contracted in its transverse sectional area; and the length of the cutting prolonged, that the trench may contain the same total number of cubical yards (1,733,760), the time required for the completion of the work, would consequently be increased inversely as the contraction of its transverse sectional area. If, for example, the slopes were reduced to 1 to 1 (instead

of 2 to 1 as we have made them above), the time which would be occupied in the excavation alone, of such a trench (working at both ends of it) would be extended to upwards of 7 years; for

$$\frac{32+40+32}{4} = 26 \times 3 \times 1550 = 120900;$$

$$\text{and } \frac{1,733,760}{120,900} = \frac{14\frac{411}{1309}}{2} = 7\frac{905}{1309}$$

This appears to me to be a plain and practical solution of the *earth-work* question. If my assumptions be correct, the conclusions are inevitable.

WM. TAIT, C.E.

14, Grafton-street, Fitzroy-square.

*Mismanagement of the Madras Military Fund.*

BY OMICRON.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—The extensive circulation of your Magazine in all parts of the world, induces me to request the insertion in your pages of the following remarks on a subject which, at the present time, is of considerable interest to all who are connected with British India. The topic to which I wish to call attention is the *Madras Military Fund*, an Institution founded in the year 1808, for paying annuities to the widows and children of officers of the Madras army, and which has had the misfortune almost ever since its first establishment, to be subject to a course of misrule which now appears to have reached its acme, unless the ingenuity of its managers shall enable them really to out-Herod Herod.

It would be, I conceive, little better than a truism to assert, that it is of the first importance for an Institution of this description (which partakes of the nature of an assurance company or a benevolent and endowment institution) to be based on the strictest rules of equity; for, otherwise, it would be vain to look for permanence and stability to the Institution, or satisfaction from the persons interested in its welfare. Now if we proceed to inquire concerning the Institution in question in this manner, and to analyze its rules, its practical working, and above all its management, we shall find the strange inconsistency of an Institution possessing a large revenue and extensive capital, conducted on a set of rules the most undigested and confused that it is

possible to imagine; so much so, indeed, as to defy all attempts to render them consistent with common sense, or prove them just and equitable. And further, we shall be struck with this singularity; that whereas other Institutions of a similar nature apportion their benefits to the sum that is paid by the individual subscriber, this one *gives the largest amount of benefit to those who contribute the smallest sum to its support*. For this Fund—the primary object of which was to secure annuities for the widows and children of deceased officers, and to provide for their return to their native country—has at various times so altered and enlarged the scope of its operations, by embracing other objects than this, the fundamental one of its establishment, that at last it presents the strange anomaly I have mentioned. The additional objects adopted by the Institution are—providing for the return to Europe of subaltern officers who are sick; increasing their pay when absent on leave from ill-health; and providing for their return to India on their recovery, &c. Now these latter objects, which are only awarded to subalterns (who pay the smallest sums towards the Fund), are in themselves most benevolent: but the *pro rata* payments to the fund, have either, in the first instance, been so badly calculated, or the fund has been so mismanaged and impoverished by repeated alterations and extensions of its original scope, that it has more than once been on the eve of insolvency. But, by a strange inconsistency, it has always been the widows' pensions which have suffered diminution on these occasions, instead of their being upheld at all hazards, as having been the original object for which the institution was founded; for not only were they entitled to priority on this account, but the managers and supporters of the fund were bound in honour to fulfil their engagements with their deceased brother officers, and not allow their families to suffer by any subsequent mismanagement.

But, however, it is not with these long past errors that I am going to contend; there are enough of a recent date to call forth the fullest measure of condemnation; and I propose two questions for consideration, namely,

First, Are not the present managers and supporters of the Fund bound by the strictest ties of honour and justice to their deceased brother officers, that their widows and children, now annuitants on the Fund, shall, under no circumstances suffer by *any new regulations*; and,

Secondly, Ought any of the *fundamental laws* of the Institution to be abrogated, or its funds diverted to other

channels than those originally contemplated, without the consent of the entire body of subscribers.

The large sums which have been paid to this Fund by many officers of high rank, who subscribed to it *for the purpose of securing to their families a handsome annuity*, and who, themselves, never received the smallest benefit from the Fund, in the same way as many of the subalterns who have availed themselves of the alterations that have been introduced in the regulations—imperiously calls for the strictest fulfilment of the engagements under which *they* became subscribers; and if, by the admission of new claims on the Fund, of a totally different character, the finances are not equal to meet the disbursements, then there can be no question which class of claims ought to have the preference. The loss ought certainly not to fall on the annuitants already on the Fund, because the cause of the deficiency has arisen solely from the introduction of injudicious rules, over which they could have no control, and which formed no part of the regulations when the money was paid by their deceased husbands or fathers, for securing a certain benefit to them, on the faith of *their existing covenants*. Now one of the *fundamental laws* of this Institution was, that no widow whose extraction was not a certain number of removes from the *native black*, should be entitled to the benefits of the fund. This “exclusion clause”—*one of the fundamental laws of the Institution*—has now been abrogated; and this measure has been taken, however extraordinary the assertion may appear, without any calculations being made as to the ability of the Fund to meet the greatly increased charge which the alteration will produce. This gross error has been perpetrated by a body of men who appear incapable of appreciating the extreme absurdity of such a proceeding; but who have done it in accordance with the wishes of the East India Company, and have thus fully made out their claim to be considered good soldiers, by obeying orders *without presuming to think for themselves*.

The threat made by the East India Company that they would withhold their gratuity from the Fund unless the “exclusion clause” were expunged, was utterly unworthy of them. They had sanctioned the clause for thirty years, from the time of the first establishment of the Fund, and they could have no right now to object to it so strongly. And what if they did? If the Directors and subscribers to the Fund had been true to themselves, they would, before agreeing to such an alteration, have ascertained whether the Fund would lose

more by foregoing the Company's gratuity, or by admitting so large an increase in the number of annuitants: but to adopt the latter alternative, without at all knowing their ability to meet the demand, were indeed a folly of which the most inexperienced ought to be ashamed. That this folly has really been perpetrated, the memorial from the Directors of the Fund, to the East India Company, abundantly proves.

It should also be observed, that many of this new class of claimants now admitted to the benefits of the Fund, are persons who have moved in a most inferior situation of life. These are now placed on an equality with European ladies, whose education, habits, and connexions, entitle them to a rank totally different from that of the "*black ladies*" who are now allowed equal participation with them. But this is not all: for, as there is but little doubt that the Fund cannot bear this additional burthen, it is hinted that the pensions of the original annuitants must be reduced to compensate for the increased charge brought on the Fund by the abrogation of the "exclusion clause." This monstrous injustice I never can believe will be attempted: if it be, it will form a lasting stigma on the honour of the Madras army collectively, and a blot on the character of every individual subscriber who votes for the measure.

If the regulations of this Fund are to be continually subject to alteration in the way they have been of late, no man is safe in subscribing to it. He had far better invest his money in an insurance office, or in some family endowment institution, where he is at least sure that the covenants made will be honourably and faithfully performed. As regards the annuitants now on the Fund, it may be satisfactory to them to know that their claim for the *full amount* of their annuities is good in law; for if they suffer any diminution in the amount of their income, and it can be proved the loss has arisen from alterations in the laws of the Institution *since the period when the last payments to it on their behalf were made*; by filing a bill in a court of equity, they could unquestionably obtain redress against the responsible managers of the Company, if their own sense of honour is not sufficiently strong to constrain them to do justice without such an appeal.

With regard to the second question proposed. The "exclusion clause," which has now been abrogated, was a *fundamental law* at the original formation of the Fund: and although in all associations the minority are bound by the

acts of the majority, *in all common cases*, where the suffrages are fairly taken ;—still, I do not think that the fundamental laws of any institution can be altered, nor can any new law be introduced in direct opposition to the spirit of the original regulations of the Society, without the consent of *every individual member* ; unless the original deed under which the institution was formed, contains, contrary to the usual course, a special clause to that effect. For a clause which empowers the making of by-laws, does not sanction any alteration in the constitution of the Society. When difference of opinion among the subscribers prevails on fundamental points, if these differences cannot be reconciled, the only way is for the majority to purchase the interest of the objectors who insist on the fundamental laws of the Institution being fulfilled. In the present instance, however, this is manifestly an impossibility, because their number is so large that the Fund would be unable to accomplish the object. Therefore, if equity guided the councils of this Institution, one of these two plans ought to be adopted,—either the fundamental laws ought to be respected, or the Institution ought to be broken up, and a new one formed on a different basis: the Fund transferring all their present liabilities to some assurance office for a specific sum of money, and the residue to be equitably divided among the surviving subscribers.

The present situation of the Fund admits of but one remedy to avert its destruction,—that every subscriber shall agree to its being entirely remodelled on a new and judicious foundation. The resignation of the whole body of Directors, which has just taken place, offers the most favourable opportunity for carrying this into effect ; and a more fortunate event for the Fund could scarcely have occurred, than that this body of “sages” should at last have taken umbrage at their talents not being appreciated, and have determined to relieve the Fund from the effects of their most inauspicious management. The Directors of the Fund long since took the opinion of a gentleman of experience on the subject of remodelling the Institution, but his strictures on its mismanagement were too just and pointed to procure for his report a favourable reception. Let the subscribers now take the matter into their own hands, and apply to some other able man, (Mr. Corbeaux, for instance, who is well known for his statistical works) and submit the two reports to persons competent to decide on their respective merits, and from these prepare rules for their future guidance; all parties

agreeing to abide by such decision. In adopting this course, however, I consider they are bound in honour that no new rules shall operate prejudicially on those annuitants already on the Fund: and they are, as I have already stated, amenable to them in equity, as no vote of the subscribers can release them from their liabilities to the annuitants. Security to the Institution compels its immediate and complete revision, for however large the funds at command may be, if they continue to be administered with such child-like imbecility as heretofore, it is utterly impossible but that they must ultimately fail.

Trusting these remarks may have the effect of calling attention to the subject in a proper manner,

London, 18th Feb. 1836.

I am, Sir, &c.,  
OMICRON.

*Experiments with Heated Metals.* By H.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—In the 10th Number of your Magazine you inserted a letter of mine, mentioning an experiment with red-hot iron. I am induced to send you an account of another experiment with heated metals which is apparently of a still more anomalous character.

When a piece of iron is heated to any temperature below redness, if it be rubbed with a piece of chalk, in a dark place, the iron becomes luminous, emitting a beautiful white phosphorescent light. The brightness of this light increases with the temperature of the iron, up to about 700° or 800°, but at a red heat, the pale light produced by the chalk is obscured, and can barely be distinguished. I have tried the same experiment with *lime*, but the like results do not obtain: for either there is no light emitted from it, or if there be, it is so feeble that I am unable to distinguish it. I have also tried the effect of using brass instead of iron, and find similar results with both metals.

In the 4th Report of the British Scientific Association, there is an account of some experiments by Dr. Williams, "on the phenomena of low combustion" which appear, in some respects, to be singularly at variance with the above experiment. Dr. Williams found that by heating *combustible substances* to any temperature below a red heat,

they became slightly luminous in the dark; and that the most convenient form of exhibiting this phenomenon, was by placing small portions of the substance to be tried on a heated bar of iron. He, however, found that *the presence of carbonic acid gas completely destroyed the effect.*

In the experiment I have detailed above, it will be observed that the effect described was produced by one of the most incombustible substances in nature—*lime*, in combination with that which Dr. Williams found to neutralize his experiments—*carbonic acid*; and in this experiment the carbonic acid must have been, if not the sole cause, at least the principal one, of the effect produced; because pure lime produced little or no effect. The result of the experiment appears altogether anomalous, for it cannot arise from the decomposition of the carbonic acid by heat, the temperature being far too low to produce that effect; and also because, if that were the cause, the same result would obtain from any heated surface. But this does not appear to be the fact; for I have tried some non-metallic substances, but no such effect is produced: and Dr. Williams also employed about the same heat in his experiments, which produced so different a result.

Dr. Williams was of opinion that the light which he observed was *not* phosphorescent, because the phenomenon only appeared in the presence of atmospheric air. Whether or no this is also the case with the light obtained by rubbing heated metals with chalk, I have not ascertained: but the appearance of it certainly is of a phosphorescent character.

I am Sir, yours, &c.

London, 13th February, 1837.

H.

*M. Pambour's Rule for calculating the Friction.*

By A NOVICE.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—Hoping that some small portion of the Railway Magazine will sometimes be devoted to the instruction of the novice, perhaps you will pardon my presumption in addressing you one question. In the 11th Number of the Magazine you pointed out several important errors in M. de Pambour's new work. At page 99 of the same work, he gives a rule for finding the friction per ton of a waggon in *descending* an

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inclined plane which, he says, may be found by dividing the distance gone over by the height. Now, sir, according to his own table, page 109, the friction per ton on a plane of  $\frac{1}{163}$  is 13·76lbs., whilst on a plane of  $\frac{1}{288}$ , a less inclination, it is only 7·78lbs. Pursuing this equation further, a plane of  $\frac{1}{10}$  will give 224lbs, friction, whilst at a less inclination of  $\frac{1}{100}$  it will give only 22·4lbs.—Trusting that you will condescend to give me a word or two in answer, I remain, Sir, &c.,

A NOVICE.

[The two cases alluded to by our correspondent are the results of two different experiments on two different trains, both calculated by the same rule p. 99 to which he refers. In one case a tender only was the body experimented with; in the other a train of 17 wagons, a tender, and an engine. The difference in the results is not the consequence of any error or inconsistency, but of the difference which actually exists in the friction of the two trains.—EDITOR.]

*On the Practicability and Advantage of employing Steam of great density, expansively, in Locomotive Engines.*  
By W. G. A., Esq.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—The grand object in Steam Locomotion, is the production of the requisite motive power from the smallest quantity of fuel and water, and with an apparatus of the least possible weight and magnitude; and this object, I conceive, would be most effectually promoted, in all its branches, by increasing the usual density of the steam, and at the same time employing it *expansively*.

The greater space requisite for the operation, *expansively*, of steam of ordinary density, renders that mode of employing such steam unsuitable to the narrow compass of the Locomotive Engine; besides which, the greater friction which would necessarily be incurred, would greatly impair the advantage to be derived from so employing it. But in fact, setting aside these objections, it would be impossible to employ steam of the common density, to any considerable extent, before its force would arrive at an equilibrium with the resistance of the atmosphere, and the friction of the engine. These

observations, however, do not apply to steam of considerably increased density, besides which, the higher temperature of such steam, renders its elastic force more than proportionate to its greater density, which, together with the greater preponderance of its pressure over the atmospheric resistance, gives its generative, as well as its expansive force, a decided advantage over steam of common density.

The usual pressure of the steam employed in Locomotive Engines is about 65 lbs. per square inch, being an effective pressure, or excess above the atmospheric resistance of 50 lbs. per inch. Now, in order to show the advantage in point of power, which steam of greater density, used *expansively*, would possess over steam of the common density, employed in the usual way, let it be supposed that instead of steam of the density corresponding to 65 lbs. pressure, steam of four times greater density were employed, and that instead of being admitted into the cylinder during the entire stroke of the piston, it were cut off at a portion of the stroke, inversely proportionate to the greater density of the steam, which in this case would be at one-fourth. It is obvious that the weight or quantity of steam expended at each stroke, supposing the same cylinder to be used, would remain the same, while the pressure on the piston, instead of 65 lbs. per inch, would be (independently of the increase of pressure due to the higher temperature of the steam) 260 lbs. for  $\frac{1}{4}$ th the stroke, and a force, decreasing in geometrical progression, from 260 to 65 lbs. per inch for the remaining  $\frac{3}{4}$ ths, giving an average pressure for the whole stroke of 156 lbs. per inch.

Such would be the result if the temperature of the steam were in both cases the same, but the temperature of steam of the proposed density being 420°, while that of steam of the common density is only 300°, and the elastic force of all aëriiform fluids being increased  $\frac{1}{480}$ th part of their volume at 32°, by the addition of every degree of Fahr. above that temperature,\* the pressure for  $\frac{1}{4}$ th the stroke would be augmented by the additional temperature of the steam to 302 lbs. per inch. As the steam expanded in the cylinder, its temperature would of course gradually subside to 300°, but assuming the excess of its temperature to diminish

\* See Lardner on Heat, p. 58.

in the same ratio as the excess of its density, as would be nearly the case, the average temperature of the steam during the entire stroke would be  $356^{\circ}$ , being  $56^{\circ}$  above the common temperature, which increase of temperature would raise the average pressure for the whole stroke to 167 lbs. per inch. So that whilst by the one method there is obtained an effective pressure of only 50 lbs. per inch, by the other there would be obtained an average effective pressure of 152 lbs. per inch. In other words, by so increasing the density of the steam and employing it expansively to the extent proposed, we should derive from the vaporization of a given quantity of water, upwards of three times the power afforded under the present system.

If the steam were cut off at a still smaller portion of the stroke, and its density were proportionately increased, a still greater force would of course result from the employment of the same quantity of steam; or, if on the other hand, the portion of the stroke at which the steam was cut off, were larger, and the steam's density proportionately smaller, the accession of force would not be so great. However, for the sake of brevity and clearness, I shall confine the following observations to the example I have already taken, without adverting to the question, whether it might be *practically* more advantageous to carry the principle to a greater, or to a less extent.

Such, then, being the greater power which would be afforded, under the circumstances I have mentioned, by an equal quantity of steam, I shall now proceed to consider as concisely as possible, 1st. The practicability of applying that power, and the saving of steam which would ultimately be effected, after allowing for friction and other drawbacks attending its operation; and, 2ndly. The saving of fuel and general advantage which would result from the reduction that would be effected in the consumption of steam, taking into account the concomitant increase of its pressure.

It will be observed, that the pressure of the steam on the piston, in the example before us, would vary during the steam's expansion from 302 to 65 lbs. per inch. The question therefore arises, how is the power resulting from this varying pressure to be equalized? In answer to this, it is in the first place to be remarked, that if two cylinders were used, which received their steam alternately, at half the stroke of each other's piston, according to the usual arrangement in Locomotive Engines, the difference between

the greatest and least *mean pressure* on the two pistons *taken together*, would be only *half* as much as the difference in the pressure per inch on each piston *taken separately*, that is to say, while the greatest difference in the pressure on each separate piston would be 237 lbs. per inch, the greatest difference of pressure on the two pistons together would be only  $118\frac{1}{2}$  lbs. per inch. Or, if we suppose three cylinders to be employed, and the steam to be admitted into each cylinder in rotation, at every *third* of the respective strokes of the pistons of the other two, the variation in the collective pressure on the three pistons would be reduced to *one third*, or 79 lbs. per inch. And if the number of cylinders were further increased, the variation in the collective pressure on their pistons would be further proportionately diminished.

But let us suppose the number of cylinders employed to be *three*; of course, in order that the pistons of such three cylinders should commence their respective strokes in the proper rotation, it would be necessary that the cranks with which the piston-rods were connected, should be fixed at equal third parts of a circle, or at angles of  $120^{\circ}$  to each other. Now, although in ordinary cases, where the steam's pressure is uniform, the varying leverage of the cranks, renders the power of the engine unequal, yet in the case we are considering, it would on the contrary, greatly contribute to equalize the effect, because, since the steam would exert by far the greater part of its force in the first half of the stroke of each piston, during which the leverage of its crank would be increasing, it is plain that the force which would be continually acting with an increasing leverage, would greatly exceed that which was at the same time acting with a decreasing leverage; so that the increasing leverage would be much more than equivalent to the decreasing leverage, and would therefore, in a great measure, also compensate for the diminishing force of the expanding steam simultaneously in operation. In short, the power of an engine thus worked expansively with three cylinders, would by these means be rendered actually more uniform, than that of a common two-cylinder engine worked in the usual way. For, supposing the connecting rods to be of five times the length of the cranks, which is about the usual proportion, it will be found that the power of the three-cylinder expansive engine would only vary in the proportion of about 5 to 4, (5 expressing the maximum, and 4 the minimum,) while the variation in the power of the two-cylinder engine worked

with steam of uniform pressure would be in the proportion of about 7 to 5.\*

The mechanism of the steam-valves would of course be different, and probably necessarily somewhat more complex, but no material difficulty would be experienced from this source.

It may also be observed, that by employing three cylinders, the operation of the steam would be so divided, that no great concussion would be produced by the full force of the steam coming suddenly into action, or, at all events, such an effect might by very simple means be sufficiently obviated.

Next, with regard to the friction of an engine thus worked expansively with three cylinders, as compared with that of a two-cylinder engine, worked in the usual way, and consuming an equal quantity of steam, but of the common pressure. No very material increase of friction would be occasioned simply by the employment of three proportionately smaller cylinders, instead of two larger ones; but the friction would no doubt be very considerably increased in rendering the pistons and valves equally steam-tight under the greater pressure of the steam. The effect also of the full force of the steam coming into play on each piston when its crank and connecting rod were both in the same line, would be, to increase the stress on the cranks and the axle of the working wheels, and thereby to add to the friction of the joints of those parts. However, all things considered, and particularly bearing in mind that the three cylinders of such an engine would be collectively, only of the same size as the two cylinders of the common engine with which it is compared, I cannot think that the friction of such an expansive engine would be more than proportionate to the greater effective pressure of the steam employed, or more than about three times the friction of an ordinary engine consuming the like quantity of steam.

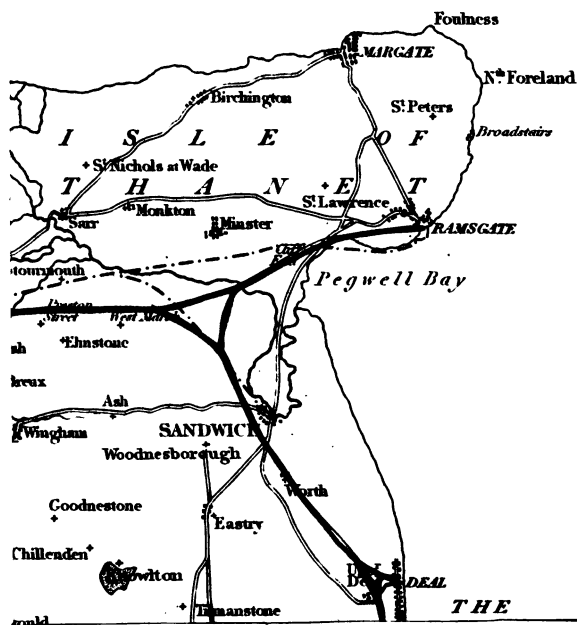
The force requisite to inject the necessary supply of water

\* It will be easily seen that the combined effect of the collective leverage of the cranks, and the collective pressure on the pistons would be greatest at one-fourth of the *up*-stroke, and least at the termination of the *down*-stroke of each piston. For the mode of computing the varying leverage of a single crank (from which the variation in the combined effect of several cranks may be easily deduced), see "Farey on the Steam-Engine," p. 416. No loss of mechanical power would be occasioned by the principal force of the steam operating with a short leverage, the smaller intensity of the effect being compensated by its greater duration. See "Farey on the Steam-Engine," p. 419, n.



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TO RAMSGATE



into the boiler against the increased pressure of the steam contained in it, would be considerably more than proportionate to the greater power of the steam; but, on the other hand, the force required to expel the expended steam from the cylinders would be materially less than proportionate to the power of the steam; and the differences in the force required for these purposes would about neutralize each other. The general resistance, therefore, or dead weight of such an expansive engine would probably not be more than proportionate to the greater effective pressure of the steam: if so, we have still left for the ultimate efficiency of the engine upwards of three times the power usually obtained from the same expenditure of steam. Hence, therefore, an engine of *equal* power thus worked expansively, would consume less than *one-third* of the quantity of steam, or, allowing a little for the somewhat greater relative friction of a smaller engine, say *one-third*. (To be continued).

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### *Kent Railway.*

WE insert a plate of this line in the present Number, but have not been able to get the materials together for a description of it.

While we have this line before us, we cannot but lament the treatment it has experienced in two successive sessions. Far is it from us to advocate any unfair practices, but why is this line to be singled out and made the scape-goat for all the rest? Deal out the same measure to all and there can be no objection. This company is accused of having gotten its deed unfairly signed. Is there scarcely one that has *had* it fairly signed? We can point out a line, now one of the best paid up, and bidding fair to be one of the most successful, which, when it came before the House, had not cash enough to stand a three days' contest. Several other favourite lines have been in a similar situation. It is well known that not one company in a hundred could pass, if *bonâ fide* it was obliged to have its capital subscribed. One of the men who signed this deed, we have heard, asserted it was the seventh this session he had signed.

We have no connexion with this company, and though we have great personal respect for one or two of the directors, we would not step a foot out of our way to help the company as a body; but, on the broad principle of justice, we cannot help repeating our conviction, that there has been more ill feeling shown to it than is its due.



Its situation has been peculiarly difficult. The engineers have been changed. Two millions were the original capital, above half of which, we understand, was most honourably signed, when all at once, and but a day or two prior to depositing the plans, &c., the new engineer declared the capital must be three millions. To get the other half million signed up was a matter of absolute necessity to save the concern, according to the standing orders, and here it is we have heard that the shabby sheep, if there are any, appear.

But who are the real accusers, we should like to know? We have heard it is the rival line, the South-Eastern; but we have been most solemnly assured since, and we believe it, that it is not. It originates, we apprehend, in the Stock Exchange, and from private pique. If so, it is the more inhuman and detestable, and we hope the House will look closely into it.

A Committee of the House has been appointed to sift the matter. We hope it will be done thoroughly, and impartially; and if what we have heard be true, we have little apprehensions for the result, as far as regards the directors, officers, and acknowledged agents of the company. If any friend, in his zeal for the cause, has of his own accord overstepped the strict line (which however we do not know), we trust, in common fairness, in common justice, in common honesty, his sins will not be visited on the innocent directors and shareholders.

With respect to signing the deed by "*men of straw*," we have heard that a noble lord of the highest authority and experience in these matters, has declared it would have no weight whatever with him. Are not "*men of straw*" often employed to do this for *men of wealth and standing*, who wish to support these undertakings but object to see their names to the deeds.

We cannot trust ourselves to comment on the conduct of the petitioning parties against the company, but we have no doubt the Committee will be particularly cautious of the testimony of such men.—ED.

## SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

*Medallic Engravings.*—Our readers are probably aware that this beautiful art, which is of very recent origin, has excited such attention as to come under the notice of a committee of the House of Commons. The first hint of this art appears to have been given "in a French work, called '*Manuel de Tourneur*', of which a second edition appeared in 1816." "In this work," says Mr. Bate,

in a letter to the Editor of the "Literary Gazette," "a process was given by which in a rough way embossed surfaces can be drawn or laid down upon a plane surface, with the effect of relief." This is called the old method. We will endeavour, as far as we are able, to give our readers a brief description of it, as well as of the improved process, by Mr. Bate and Mr. Froude. Imagine a horizontal plane on which any figures whatsoever are drawn, and another, on which these figures are to be transcribed, perpendicular to the former plane, and facing the west. If at the extremities of two arms at right angles to each other a tracing and an etching point are fixed; and if, while the tracing point passes over the horizontal figures, the vertical plate follows, always parallel to itself, the etching point in such a manner, that it sinks exactly as much as it advances westward, and the contrary, it is easily seen that the figures of the etching point will be perfectly equal and similar to those described by the tracer. In fact, they will be perfect copies of them in situation, size, and figure. Now, suppose the tracer to pass, directly from north to south, over the surface of a figure in relief, the etching point would faithfully describe this vertical section on its plate; but every point would be just so much out of its true situation relatively to a line corresponding to the north and south line on the horizontal plane, as the corresponding point of the figure in relief is above or below the level of the horizontal plane. While a horizontal figure, therefore, may be accurately described, a figure in relief will be distorted, and by just so much more as the relief is more bold.

Such we understand to be the principle of Mr. Achilles Collas, a Frenchman. Mr. John Bate, of the Poultry; and Mr. William Froude, a son of Archdeacon Froude, seeing the errors of the old method, have both, but independently, it seems, fallen upon the same way of avoiding them.

Their process consists in making the tracer, instead of describing right lines north and south, pass over imaginary sections of the medal inclined to its plane in an angle of  $45^{\circ}$ . By this means, wherever there is a relief the tracer will describe a curve, and the etching point another on the vertical plane. What vertical motion is given to the vertical plate, to preserve the true relative horizontal situations of the various points on the medal, is not clear from any description we have seen. It appears to us, that to give every point its true position, the vertical plane, besides descending exactly so much as the tracer advances horizontally westward, must also rise or fall just as much as the tracer does. In other words, relatively to the tracing point, the vertical plate must have but one motion—a vertical one, precisely equal to the absolute easting or westing of this tracing point.

After the etching point has truly sketched out the figure, it belongs to the tool of the artist to give it effect.

But, whatever be Mr. Bate's or Mr. Froude's system, it appears

from the account given in the *Literary Gazette* of Feb. 11th, the best we have seen, and from which we have endeavoured to furnish the above outline, that the testimonies of its accuracy, and, therefore of its superiority, are decisive. We have seen some of Mr. Bate's productions, and can say, they are exceedingly beautiful. We shall be glad to hear that he has reaped the reward to which his ingenuity and the great expense he has been at, in prosecuting and patenting his invention, entitle him.

*Climate of Montreal, America.*—It is a curious fact, that notwithstanding the neighbourhood of Montreal has been improving in cultivation and population, its temperature has been diminishing for several years, as the following table, from the *Montreal Herald*, the results of daily observations from a fixed thermometer, proves.

Mean-Temperatures of the Year.

1826 .....	47·1	1831 .....	46·8
1827 .....	47·7	1832 ..	44·7
1828 .....	47·3	1833 .....	44·8
1829 .....	46·0	1834 .....	45·0
1830 .....	47·8	1835 .....	42·9

This city is 5° southward of the parallel of London.

*Continuous Bearings.*—We are pleased to find by the Great Western Report, that Mr. Brunel is adopting the same system of laying the rails on continuous bearings of wood as Mr. Vignoles. There is a little difference in the plan and some in the expense as proposed by these gentlemen, but the principle is the same.

*Height and Depth of Clouds.*—It appears by some experiments made by Capt. Peytier, Sept. 29th 1826, in the Pyrennees, that the lowest surface of the clouds was 450 metres, and the highest 900, thus leaving a thickness of 450.

*Acoustic Pyrometer.*—M. M. Cagniard-Latour and F. Demonferrand, have invented an instrument by which they propose to measure temperatures by the sound. The method is not described, but the authors say, "that they propose to themselves not only to furnish philosophers with an instrument to measure the most elevated temperatures, but to give to industry a prompt and easy means of appreciating them with accuracy in all degrees of the scale." The priority of the invention has been claimed for M. Hoene Wronski.

*Magnetic Intensity in the Higher Regions.*—In discussing his numerous observations in the Pyrennees, Professor Forbes has found a diminution of intensity equal to 0·0001 for every 1,000 yards of elevation. It was supposed there was none for any heights we could reach.

*Maximum Density of Water.*—M. C. Despretz has read an account of some experiments to the Academie des Sciences, in which, from numerous experiments with water thermometers, alternately mixed with mercurial, he finds the maximum density of pure water to be at 4° Cent. or 39·2 Fahr. He finds that all saline solutions

have likewise points of maximum density. But the most important of all the circumstances is, his having cooled pure water down to  $20^{\circ}$  of Cent. or  $33^{\circ}$  of Fahr. below the freezing point, without freezing it. Thomson and others have gone to  $10^{\circ}$  or  $12^{\circ}$  of Fahr., but we never yet heard of any thing approaching  $33^{\circ}$  before.

*Resolution of Algebraic Equations.*—M. Libri announced verbally to the Academie des Sciences, at their sitting, on the 30th of January, that he had discovered a method of representing in finite algebraic terms of the algebraic coefficients of an equation of any degree, the number of its real roots and their several approximate values as well as those of the imaginary roots.

*Agricultural Meteorology.*—M. Boussingault has deduced the following curious consequence from facts relative to the times between the beginning of vegetation and the maturity of annual plants in different climes. He says if the mean annual temperature of the place in centigrade degrees be multiplied by the number of days between maturity and the commencement of vegetation, the product will be a constant quantity; so that the colder the clime the more rapidly and in determinate ratio does vegetation, when it commences, proceed.

*Influence of the Height of the Barometer on the Mean Level of the Sea.*—In our last vol. p. 318, we mentioned, on the authority of Mr. Lubbock, that the height of the tides at Brest, are affected as much as 8.78 inches by a change in the barometer of 0.622 inches. In the *Connaissance des Temps* for 1839, which has lately reached us, M. P. Daussy says this fact has been established by 1400 observations. The ratio of 8.78 to 0.622 is nearly that of 14 to 1, or of the specific gravity of mercury 13.3 to that of water 1. This proportion does not hold every where; at Liverpool it is 10 to 1.

*Astronomical Refraction.*—The French are sedulously engaged on this difficult subject. M. Biot has a paper of no less than 114 pages in the *Connaiss. des Temps*, for 1837, on the discussion of it. We have long been in possession of a theorem which we think will settle this question.

*A Wind-Wheel for Propelling Vessels.*—A mechanic, we hear, has proposed a new sort of motion-wheel, by which he expects to be able to use the atmosphere as we do steam, for the propulsion of vessels. We do not know his plan, but he lays claim to the assistance of all winds, and will allow none to be contrary. All that we can say is, we hope his claims will be speedily followed by successful possession.

*American Estimate of English Physicians.*—In speaking of the evidence of the medical men on the Brighton lines last year, the editor of the *American Railroad Journal* observes, "We would advise most respectfully, that the next time such a subject is before them, that the House of Commons send for an American engineer, instead of listening to the mass of nonsense usually offered."

Doubtless, this advice will be "most respectfully" followed. We do not wish for one moment to depreciate the abilities of American engineers—though we must confess it a little startles us to see them coolly talk of carrying railroads over mountains—but we would quietly ask the editor if he does not think the advice he offers savours strongly of vain glory and arrogance!

*Steam Power to Tillage.*—At the annual meeting of the Highland Society, held at Edinburgh, the society proposed to give a premium of 500*l.* for the first successful application of steam power to the cultivation of the soil. The Marquis of Tweeddale moved for carrying it into effect, which was seconded by Professor Low. Mr. Robinson opposed the appropriation of so large a sum for this purpose. The Duke of Buccleuch approved of a liberal premium being offered, as affording something like compensation for the expense of experiments. The premium was unanimously agreed to as proposed.—*York Herald.*

*Candle-tree Oil.*—This is another solid oil which the writer has never had an opportunity of seeing in a state of purity.

It is obtained from the seed of the *Croton sebiferum*, or Candle-tree, a native of China. The Chinese manufacture it into candles, mixing it with resin and olibanum, and perhaps also minia batta. The writer has procured several conical masses, of a mixture probably of this kind, which consist of different layers as if they had been dipped, and are supplied with a hollow in the centre filled with pappus or medullary matter.

These incipient candles, as they might be termed, have a strong odour of cocoa-nut oil, or minia batta. The common candle of Chinese, which may be a subsequent state of these masses, resembles an English rushlight, and has attached to its lower extremity a stick which answers for a handle. The Chinese, according to Dr. Steele (to whom the writer is indebted for the specimens), term the candle-tree oil *Coo-yow*, *yew* or *yow* signifying oil; the resin with which they mix it *Cow-hoo hing*, and the olibanum *hong hing*.—*Thomson's British Annual.*

*Animal Chemistry.*—The importance of the subject has induced us to make room for the subsequent observations.

*Chemistry of the Digestive Organs and Mucous Membranes.*—It is a remarkable circumstance, that physicians seem to disregard the application of chemistry to medicine, as if the former science had no connexion with the latter art, although it must be obvious to the most trivial student, that all the processes which take place in the human body are of a chemical nature. The food is first masticated, this is equivalent to the preliminary steps adopted in chemistry, the trituration and levigation of powders, for the purpose of rendering them subservient to the action of decomposing agents. When the food has been thus rendered soft, and deprived of its tenacity, it is carried into the stomach. There it is mixed with the fluids of that organ, which are poured out in great abundance when the stimulus of food is applied to its coats.

The most important constituent in these fluids is muriatic acid, which exists there in great abundance, as has been demonstrated by the most satisfactory experiments of Prout, Tiedemann, Gmelin, and Braconnot. In the stomach the masticated food alters its appearance, and in some degree its immediate constituents are changed; it is converted into what physiologists term chyme—a thick whitish mass, of a considerably viscid consistence. Now, it is a curious fact, that if we take a portion of flesh—such as a bit of beef—cut it into minute fragments, and then digest it for several hours in very dilute muriatic acid at the temperature of about 100°, a thick fluid results exactly resembling chyme, and this fact leads us to the inference that the principal agent in the formation of chyme is muriatic acid. After undergoing this change in the stomach, the food passes into the intestines, where, by the influence of the bile, it is converted into a white fluid like milk; this is taken up by certain absorbents, whose mouths terminate in the gut, and is carried into the thoracic duct which leads up to the heart, where it is mixed with the blood. The blood, after passing through the lungs, where it undergoes some change, which is not as yet understood, (our ignorance proceeding undoubtedly, from the want of attention paid by physicians to chemistry,) and returning to the heart, proceeds to the different parts of the body by the medium of the arteries. In its course it secretes the urine, the pancreatic and splenic juices, and all the other secretions which tend, either directly or indirectly, to nourish the body and supply the waste which it is continually undergoing, for it may be aptly compared to a fire which burns with great vigour, and is continually requiring fuel to prevent it from being extinguished. In the organs which perform the secretions, that portion of the blood which passes through them is completely altered in its chemical constituents. In the fluid secreted by the kidneys, we find a large quantity of urate of ammonia and sal ammoniac, not one of which exists in the blood.—*Thomson's British Annual.*

*Van Mons' method of raising Fruit-trees from the Seed.*—(From the "Genesee Farmer.")—We published, a few weeks since, from the Boston Horticultural Register, Gen. Dearborn's introductory remarks to the account given by A. Poiteau, of the means which were employed by Van Mons to obtain excellent fruit from the seed. Omitting the speculative part of the article, we here give, as briefly as the nature of the subject will admit, the most interesting and useful facts, which were developed during the course of the experiments of Van Mons, with the hope that it may induce others to follow his example, even though it be on a very limited scale.

Van Mons laid the groundwork for his experiments by collecting, during excursions through every part of the surrounding country, wild and natural stocks of fruit-trees, which exhibited a favourable appearance, and which, from his familiarity with the

characteristics, he was enabled at once to select, by means of these acquisitions, and repeated sowings from them, he had, in a few years, 80,000 fruit trees in his nursery, which enabled him to make his experiments on a large scale, and to obtain results more promptly and with greater certainty. "His repeated successive sowings," says Poiteau, "of annual flowers, and perennial shrubs which grew and fructified in a short time; his excursions to observe the wild type of our fruit-trees, in places where they grew and reproduced in a state of nature; his new generations, which were obtained from wild and free or natural stocks, as well as from the first sowings in his nursery; his thousands upon thousands of observations collected from every quarter, have enabled Mr. Van Mons to establish a law which admits of no exceptions; this law is, that so long as plants remain in their natural situation they do not sensibly vary, and their seeds always produce the same, but, on changing their climate and territory, several among them vary, some more and others less, and when they have once departed from their natural state, they never again return to it, but are removed more and more therefrom, by successive generations, and produce, sufficiently often, distinct races, more or less durable; and that finally, if these varieties are ever carried back to the territory of their ancestors, they will neither represent the character of their parents, nor even return to the species [variety] from whence they sprung."

Another very important conclusion at which Van Mons arrived, from a long series of observations, was this:—While pear-trees, in a state of nature, and in their native soil, always reproduce seeds without any sensible variation, the seeds which a domesticated pear,—that is to say, one that has been for a long time in a state of variation in consequence of a change of climate, or other cause,—yield, at its *hundredth* fructification, produces trees, not only very different from itself, but still very different from trees which have been produced from the seed of its *first* fructification; and the older a domesticated pear becomes, the nearer do the trees produced from its latest seeds approach to a state of nature, without, however, ever returning to it.

Having arrived at this conviction, he concluded that "by sowing the first seeds of a new variety of fruit-trees, there should be obtained trees always variable in their seeds, because they can no longer escape from this state of variation, and which are less disposed to return towards a wild state, than those produced from seeds of an ancient variety; and as those which tend towards a wild state have less chance of becoming perfect, according to our tastes, than those which are in the open field of variation, it is in the seminary of the first seeds of the newest varieties of fruit-trees, that we should expect to find more perfect fruits."

The above quotation comprises the whole theory of Van Mons. It was to verify it, and put it in practice, that from that period

he collected in his nursery young wild trees, young free stocks,\* and sowed large quantities of the seeds and stones of various kinds of fruit trees, in order to have their *first* fruits, and sow their seeds in turn to obtain a generation, of whose novelty he was sure, and to take it as a point of departure for his experiments. Although Mr. Van Mons operated on thousands of various kinds and different varieties of trees at the same time, I will assume, in order to render what I say more clear, in explaining his progress, that he made his experiments on a single variety of pear.

(To be Continued.)

## REVIEW OF BOOKS.

*The Advantages of Railways to Agriculture; and Observations on the general importance of Railways.* — Simpkin and Marshall. A very sensible and well-written pamphlet, containing much useful matter, has been published under the above title, by Messrs. C. W. and G. W. Johnson, Barristers-at-law. We regret we have not room to make any extracts from it.

*Connaissance des Temps for 1839.*—This national Almanack has just reached us, and is much improved in its matter and construction, except, we think, the Ephemeris part. We do not see the utility of separating the ephemeris of the planets in detached portions of the work, when a single page every month would hold them all. It is a great improvement, we grant, to have their places given for equal intervals, because they can be so much more easily interpolated, but this might have been done and still kept on monthly leaves. The bringing of all the lunar distances into one place is certainly an improvement. We believe we set the first example of this in the *New Nautical Almanack* for 1835.

A very able—as all communications of this distinguished philosopher are—and elaborate paper by M. Biot, on Astronomical Refractions, is among the additions to the present volume of the “*Connaissance.*” There is also one by M. Daussy on the influence of the barometer on the mean level of the sea; a table of geographical positions by the same; and one on the geographical positions of oriental Greece from the triangulation of M. Peytier.

Unlike our “*Nautical Almanack,*” the “*Connaissance*” retains the geometric longitudes and latitudes of the planets; we wish the same was done with the fixed stars. A more absurd and injurious system to the future improvement of astronomy never was adopted, than that of giving the places of the heavenly bodies in right ascension and declination only. It may suit the ignorance of a

\* That is, natural stocks from domesticated varieties.



parcel of amateur observers, who are unable to reduce their observations; but what can be more preposterous than to abandon the fixed plane of the ecliptic—which the sun and all the other bodies of the system, respect as their common plane,—to refer them to a plane constantly oscillating backwards and forwards, upwards and downwards, and with which none of them have any relation?

The “*Connaissance*” does not, we perceive, contain the blunder which our “*Nautical Almanack*” has perpetuated year after year, since it has been honoured with Mr. Stratford’s management; namely, in directing the annual variations in declination of certain fixed stars to be added when they ought to be subtracted, and subtracted when they ought to be added. Some allowance, however, ought to be made for the difference of men. The French managers are all men of science, but Mr. Stratford, we believe, with a very proper feeling and knowledge of himself, does not even lay claim to an acquaintance with the A, B, C, of it. We may recur to this and the “*New Nautical Almanack*” too, before long.

*The Annuaire*.—This very popular work for 1837 has but lately arrived in this country. Mr. Arago, who has for several years written the scientific notices which have raised this little work to be the most popular annual in Europe, has this year reprinted, with some additions and alterations, his *Historical Notice of the steam-engine*, which he published eight years ago. The criticisms of one Mr. Ainger, an engineer, seem to have procured us this treat. We have never heard of this gentleman. However, in common, no doubt, with numbers of others, we shall long feel obliged to him for having provoked M. Arago to benefit the world again with his remarks and observations on so interesting a subject.

The cause of all this discussion appears to have been occasioned by M. Arago having attributed the priority of the first idea respecting the steam-engine to Solomon de Caus, a native of France, a second edition of whose book, “*Les Raisons des Forces Movantes avec diverses Machines tant utiles que plaisantes*,” was published at Frankfort, in 1615, that is, about forty-eight years before the Marquis of Worcester published his “*Century of Inventions*,” from which the English date the germ of the invention. Now there is nothing we so much despise as national prejudices. An inventor, or discoverer, whose works are of general utility, is, in our opinion, the common property of the world, and his fame should be as dear to one country as to another. A Frenchman, who would endeavour to depreciate the labours of Newton, because he was born in England, or an Englishman, who would descend to so ungracious an action by Laplace, because he was a Frenchman, would deserve to be expelled from society. Our gratitude should be proportional to the benefits we receive; it has nothing to do with the place of nativity. Would a diamond be worth less because it was given by

a foreigner? Away, then, with this ridiculous national prejudice ; it is unworthy of any one, and much more of men of elevated minds.

Now setting aside all considerations of persons and country, we would appeal to any one who reads the two following extracts,—which are all the evidence we have to judge from,—to which writer the idea of a machine anything like a steam-engine properly belongs. In the one case, we see a man amusing himself with a pretty toy, without a single idea beyond ; in the other, we having one describing the operations of a machine he has invented, the internal parts of which closely resemble those of our present steam-engines, and with whose utility and gigantic powers he appears to be well acquainted. Surely there can be no difference of opinion on this very palpable subject.

We will begin with Solomon de Caus, whom M. Arago calls the first inventor of the steam-engine.

“The third means of making water ascend is by the aid of fire, for which divers machines may be contrived. I will here show one. Let there be a ball of copper well soldered round, and let a tube with a stop-cock be inserted in the upper part of it, leaning obliquely outwards, through which water may be introduced, and also another, descending vertically through the top to near the bottom, furnished with a stop-cock. Then fill the ball through the oblique tube with water, close the cock and put it over the fire, which will make all the water mount up through the vertical tube.”

To this M. Arago has added another quotation, in which Caus says, “That the violence of the vapour (produced by the action of the fire) which causes the water to ascend, comes from the said water, which vapour itself will rush out with great violence through the stop-cock, after the water has gone out.”

This is all M. Arago advances in favour of Caus. Now for the Marquis of Worcester.

“I have invented an admirable and forcible way to drive up water by fire ; not by drawing or sucking it upwards, for that must be, as the philosopher terms it, *infra sphaeram activitatis*, which is but at such a distance. But this way hath no bounder if the vessels be strong enough. For I have taken a piece of whole cannon, whereof the end was burst, and filled it three quarters full of water, stopping and screwing up the broken end, as also the touchhole, and making a constant fire under it ; within twenty-four hours it burst and made a great crack. So that, having a way to make my vessels so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant fountain-stream forty feet high. One vessel of water rarified by fire driveth up forty of cold water, and a man that tends the work has but to turn two cocks ; that one vessel of water being consumed, another begins to force and refill with cold water, and so successively ; the fire being tended and kept constant,

which the self-same person may likewise abundantly perform in the interim, between the necessity of turning the said cocks."

*The Mining Review.*—The ninth number New Series of this Journal has just appeared with increased vigour and spirit. Besides several well-written papers on a variety of subjects connected with the mineral kingdom, the editor has given very copious reviews of all the recent publications relative to mining, both at home and abroad. The work is indeed so well executed in this respect, as to be a library of itself, and an excellent epitome of all the recorded and floating knowledge of the day.

## PROGRESS OF RAILWAY WORKS,

### LIVERPOOL AND MANCHESTER RAILWAY.—TENTH HALF-YEARLY MEETING.

#### *Report.*

*Liverpool, 25th January, 1837.*—In submitting to the proprietors a statement of accounts, for the half-year, ending 31st December last, the directors have to report, that in the coaching department the general result has been favourable, as compared with former years. At the same time, they have to observe, that the depression which has been experienced in almost all branches of trade, during the last three or four months, has been seriously felt by the Railway Company in their merchandize department, in a considerable reduction of traffic, as compared with the same period of last year.

The disbursements in each department of the company's business continue heavy. It has been the constant aim of the directors to reduce them as far as practicable; but it has been with them a still more earnest and important object to afford every accommodation and satisfaction to the public, both in their carrying and coaching establishments. For this purpose they have spared no expense in improving and enlarging their stock of engines and carriages—keeping pace, as closely as possible, with the increasing requirements of the times.

They have recently made an alteration in the arrangement and hours of departure of the coach trains; introducing an additional first class train, at nine o'clock in the morning, which has proved a great public convenience.

The proprietors will bear in mind, that though, in the merchandize department, the company are subjected to unceasing competition, on the part of the three navigation companies—yet that in the coaching business, they possess, almost exclusively, the means of conveyance between Liverpool and Manchester. Under such

circumstances, the directors have been fully sensible of the responsibility which attaches to them, as managers of a great public institution, and of the jealousy with which their proceedings are regarded, not alone by individuals anxious for their own accommodation, but by the Legislature, which on more occasions than one, has been solicited to give its sanction to a rival and competing railway.\* If Parliament, taking into consideration the peculiar circumstances of this undertaking—the difficulties it had to contend with, but notwithstanding these, the beneficial results it has accomplished, and the impulse to national improvement which it has imparted, has declined to sanction an opposing scheme, it becomes only the more incumbent on the proprietors to afford that ample accommodation to the public, which shall render ordinary competition uncalled for. The directors, on behalf of the company, have felt themselves justified before the public, and the Legislature, in taking the position which they occupy; but they admit the terms on which alone it can be sanctioned; and they are sanguine enough to hope that, thus, the interests of the concern, and of the community, may become in a great measure identified; inasmuch as a liberal policy on the part of the company is the required and recognised condition, on which alone the confidence of the Legislature, and of the public, can be continued and maintained.

Since the last half-year's meeting of proprietors, the Crown-street coach station has been removed to Lime-street—and the accommodation and advantage to the public, in being afforded access, by means of the north tunnel, to the very centre of the town, without any increased charge, has been generally felt and acknowledged. The interior arrangements of the new station are completed as far as respects this company; but the prospect of a considerable accession of business on the approaching opening of the Grand Junction Railway, will render expedient an additional range of workshops, carriage-houses and offices, on the south side of the arrival gate.

The building of the proposed new arrival station at Manchester has been delayed, in consequence of the directors having received intimation of a projected line of railway to connect the Liverpool and Manchester line with the new railways about to be constructed into the interior of the country, and intended to terminate in the neighbourhood of Store-street. Having duly considered the plan of this projected connecting line, of which notice has been given of an application to Parliament in the ensuing session, the directors are of opinion that it will not be expedient, on that ground, any longer to postpone the accomplishment of those substantial improvements which may be effected in their own premises; and which, accordingly, they propose to commence in the ensuing spring.

\* The Legislature never can be so unjust.—ED.

For the completion of these, as well as for providing other required accommodations in various parts of the line, rendered necessary by the anticipated increase of traffic; and especially for the cost of substituting much heavier and stronger rails for those originally laid down along the whole line, (which work has been actively in progress during most of the past year,) additional funds will be required, which it is proposed to apply to Parliament for powers to raise. The proper notices have been advertised, in conformity with a resolution of a special general meeting of the proprietors, held in this place, on the 3d of November last. The draft of the Bill for this purpose will be read to the present meeting; after which, if the proprietors shall coincide in opinion with the directors, as to the great importance of this measure, they will record a resolution to that effect, authorising the proposed application to Parliament accordingly.

The directors will now give the statement of accounts for the half-year ending the 31st December last, which is as follows:—

*Half-year ending 31st December, 1836.*

RECEIPTS.

Coaching Department .....	£75,986	13	9
Merchandise Do. ....	45,742	16	4
Coal Do. ....	3,550	10	4
	<hr/>		
	£125,280	0	5

EXPENSES.

Bad Debt Account .....	£244	15	6
Coach Disbursement do. ....	12,627	14	8
Carrying Disbursement do. ...	10,601	1	3
Coal do. do. ....	414	8	6
Cartage (Liverpool) do. ....	168	8	2
Do. (Manchester) do. ....	3,986	9	8
Charge for Direction do. ....	347	11	0
Compensation (Coaching) do.	56	8	9
Do. (Carrying) do. ....	136	14	1
Coach-Office Establishment do.	741	2	11
Engineering Department do...	296	5	0
Interest do. ....	9,675	9	4
Locomotive Power do. ....	21,526	17	4
Law Disbursement .....	200	0	0
Maintenance of Way do. ....	4,714	8	11
Office Establishment do. ....	941	7	11
Police do. ....	1,237	1	11
Petty Disbursement do. ....	30	0	0
Rent do. ....	239	12	5
Repairs to Walls & Fences do.	1,204	2	10
Stationary Engine Disbursement ..	1,076	13	7

Tunnel Disbursement do. ....	372	19	9		
Tax and Rate do. ....	3,098	6	8		
Waggon Disbursement do. ...	5,043	8	11		
North Tunnel do. ....	647	5	7		
				79,628	14 8
Net Balance for Profit, and Interest on Capital, for Six Months .....	£45,651	5	9		
Net Balance, as above.....	£45,651	5	9		
To which must be added the Surplus in hand after paying the last Dividend.....	1,127	15	2		
Amounting together to	£46,779	0	11		
The directors recommend to the proprietors a di- vidend of 5 <i>l.</i> per share, amounting on 7,968 <i>½</i> old shares, and on 111 <i>½</i> new shares sold under the authority of the Act, (in all 8,080 <i>½</i> shares) to	40,401	5	0		
And leaving a Balance of	£6,377	15	11		
to be carried to the credit of the next half- year's accounts.					

CHARLES LAWRENCE, *Chairman.*

*Copy of Resolution passed by the Meeting.*

Resolved,—That the Draft Bill now read be approved, and that the Directors be authorized to apply to Parliament in the ensuing Session for an Act to carry the same into effect, subject to such modifications as may appear expedient, or as Parliament may direct.

*Statements of Receipts and Expenditure on Capital Account, from the Commencement of the Undertaking to 31st December, 1836.*

The Treasurer Dr. to—	£	s.	d.	The Treasurer, Cr.	£	s.	d.
Amount of joint Capital in Shares and Loans .....	1,243,890	0	0	By Amount of Expenditure on the Construction of the Way and the Works, including the new Station in Lime-street, &c. ...	1,266,969	14	4
Amount of Dividends not paid .....	1,340	6	6	Amount in the hands of Moss and Co., Bankers .....	17,156	15	3
Amount of Reserved Fund and Interest.	4,187	7	2	Do. of Balance of Book Debts due to the Company ....	12,070	5	0
Surplus in hand after payment of the Twelfth Dividend in August, 1836..	1,127	15	2				
Net Profit for the half-year ending 31st Dec., 1836 ..	45,651	5	9				
	£1,296,196	14	7		£1,296,196	14	7

N.B.—A dividend of 5*l.* per 100*l.* share having been declared by the proprietors, the treasurer will be prepared to pay the same at the Railway Office, Lime-street, between the hours of eleven and three, on and after Wednesday, the 8th February next; or the amount will be made payable at Messrs. Barclay and Co.'s, London, or will be remitted in a bill at a month, at the proprietor's option; and the dividends of parties who have given their orders, will be paid in conformity with such orders; or will be allowed in part of the call of 10*l.* per 50*l.* share, payable on the 6th February, and may be deducted from such call accordingly.

[It will be seen that this railway goes on growing in trade and prosperity, a specimen of what may be generally expected from many others. The primary object of the directors has been to improve their stock of moving machinery, carriages, &c., a policy which, added to the high price of materials for ordinary use and repairs, (iron, copper, coke, &c.,) will explain the more than usually heavy disbursements for the past year.—ED.]

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GREAT WESTERN RAILWAY.—THIRD HALF-YEARLY GENERAL MEETING.

AT the third half-yearly general Meeting of the Great Western Railway Company, held in pursuance of the provisions of the Act, at the City of London Tavern, Bishopsgate-street, on the 16th of February, 1837; ROBERT BRIGHT, Esq., in the chair; it was Resolved—

That the report of the directors now read be received and adopted.

That the corporate seal of the company be affixed to the register of proprietors now produced.

That the best thanks of the proprietors are due to the board of directors, for their unremitting exertions in the management of the company's affairs, and for the highly satisfactory report which has been now read to the meeting.

That the following gentlemen be re-elected directors of this company:—Robert Bright, Esq., George H. Gibbs, Esq., Peter Maze, Esq., E. W. Mills, Esq., W. U. Sims, Esq., W. Tothill, Esq. Signed, Robert Bright, Chairman.

The chairman having quitted the chair, it was resolved, That the best thanks of this meeting be given to Robert Bright, Esq., for his able conduct in the chair.

*Report.*

The works of the railway have been proceeding satisfactorily since the directors had the opportunity of making their last report to the proprietors; and as the season is now approaching when it may be reasonably expected that the operations of the company will be exempted from the peculiar difficulties and impediments

experienced during the recent state of the weather, there can be no longer a doubt of the completion of the line to Maidenhead at the time long since contemplated.

The directors rely with unabated confidence upon the means of opening the railway to that town in the month of October next.

In adverting to the satisfactory progress of the works during the last three months of unexampled wet weather, it is worthy of observation, that the obstruction which would inevitably have accrued to earth-work in a soil chiefly composed of clay, has but partially, and in a slight degree, affected the excavations and embankments between Acton and Maidenhead, which consist principally of gravel or light soil.

If the continued rain has in some degree retarded the works, it has also assisted in consolidating the newly made embankments, most of which now assume the appearance of works of older date, and may be deemed of permanent formation.

Between Acton and London, in fulfilment of the expressed wishes of the proprietors, such works have been commenced, and are now in active operation, as will insure their completion within the specified time.

Not only upon this portion of the line, but also in continuation of it to Reading, and between Bath and Bristol, at those points where the works admit of it, recourse has been had to labour by night as well as by day.

The value of an early employment of these portions of the line has always appeared to the directors to justify an increased expenditure, capable of being amply repaid to the proprietors out of an immediate and considerable revenue, which the traffic will unquestionably secure as a reward for those additional exertions and outlay.

There is no reason to doubt that the completion of the line between Bristol and Bath will be effected early in the spring of next year, and between Maidenhead and Reading in the summer following.

Unfounded reports were circulated industriously during the first application to Parliament, respecting imaginary difficulties to be encountered in the tunnel through the Box Hills, to the East of Bath, and it may be a satisfaction to the proprietors to know that trial shafts have been sunk, and the strata through which it passes fully ascertained, the result of which not only proves the incorrectness of such reports, but gives full assurance of the work being free from all unexpected or unusual difficulties.

The completion of the permanent shafts is now far advanced, and the works of the tunnel will be commenced as quickly as possible.

The directors would not do justice to those who have already entered into contracts with them for the construction of the railway, if they did not state, in general terms, their satisfaction with



the manner in which they respectively conduct their works, and it must be a reasonable subject of congratulation to the proprietors, that the extent of the work already done, has not been attended in a single instance with failure on the part of the contractor.

The contract for the tunnel to Chippenham, constituting the heaviest work now remaining to be undertaken upon the whole line, is advertised to be let during the next month.

The engineer is engaged in preparing other contracts to be let consecutively at such periods as will correspond with the means of opening further portions of the railway, both to Oxford and Cheltenham. Since the report in August last, arrangements have been made with the landowners for the conversion of an intended tunnel at Sonning, of five-eighths of a mile in length, into an open cutting. Although this will entail an additional expense upon the company, from the increase of earth-work, it cannot be doubted that a considerable public benefit results from the change; and it may be observed, that the proprietors are mainly indebted for it, to the facility afforded them by Mr. Palmer, M.P., for Berkshire, whose lands it intersects, and who, although individually an influential opponent to the railway, has, upon the application of the directors, consented to this alteration.

The same motives of rendering this undertaking as perfect for public use and accommodation as possible, have influenced the directors to bring before the Legislature a bill for deviating the line, so as to avoid the tunnel at Purley of one mile in length, and also for improving the railway, and lowering the summit level near Swindon.

Should this Bill pass in the present session, of which the directors cannot entertain a doubt, not only will the Great Western line, already the nearest approaching to a level in the kingdom, be further improved, but it will also be carried for nearly 100 miles from the metropolis into the west of England without a single tunnel.

The directors, have had constantly in view the great importance of reducing that which forms so large a proportion of the annual cost of working the railway, viz. the maintenance of way and of locomotive power. It has seemed to them that wherever any improvement could be introduced which would effect a saving of constant disbursement proportionate to the first increased outlay, it was but an act of prudence to adopt it, not only as a pecuniary benefit, but as more importantly conducing to the permanent advantage of the undertaking by rendering this line of railway free from ordinary competition, and calculated by its superiority to acquire and retain a widely extending traffic from its numerous branches.

The expectation of attaining these benefits has been already alluded to in preceding reports, and from a very recent and careful revision and comparison of the estimates with the actual amounts

for which the company has secured the execution of the works in progress, it appears that the increased expenditure will accomplish the object for which it has been incurred.

The reduction of the gradients, and the improvements of the curves, which will secure the degree of perfection already adverted to, have of necessity involved an increase in the cuttings, and embankments, and other contingent works.

This circumstance, as well as the means employed for the earliest possible completion of the line as before mentioned, will certainly cause an excess over the original estimate. This, however, may be now safely calculated, and it appears to result mainly from the positive improvement in the line determined upon, and not to exceed a sum which must be readily admitted as a reasonable outlay in proportion to its probable advantages.

The annual saving of at least 30,000*l.* per annum upon the whole line in those items of expenditure which are constant and unavoidable, may be expected to result from the improvements which cannot, upon the most liberal calculations, founded upon the actual cost of the most expensive works on the line, exceed 400,000*l.*

The extension to Paddington in like manner produces its obvious and immediate saving, and can only be regarded as a profitable and advantageous investment of capital. The saving of payment to the London and Birmingham Railway Company, for the use of their line, which would certainly not have been less than 25,000*l.* per annum upon an average, will alone recompence the expenditure of 250,000*l.*, to secure an independent terminus. The land is already purchased and all the arrangements made for the works in such manner as to determine accurately the cost of them to the company.

There will be some increase also over the original estimates in points which are unconnected with this voluntary extension and improvement of the works, but happily it may be stated that they will not be material in amount, which may be ascribed chiefly to the absence of those natural and unforeseen difficulties, which, although successfully overcome in other railways, have nevertheless been sources of heavy expenditure to them. The directors may add, that the amount authorized to be raised by the original Act, will, it is confidently expected, embrace all the necessary expenditure of the company, including the extra cost of the extension to Paddington, as well as the various improvements of the line. Eventually it will become necessary to furnish a much larger stock of locomotive engines and carriages for the transport of passengers and merchandise upon the whole line than is provided for in the present estimates. It will be the duty of the directors to consider, profiting by practical experience in the mean time, whether it may not be advisable to contract for the supply of the requisite power, rather than to incur for it an augmented outlay of capital.

The mode of laying the permanent rails has occupied the attention of the directors from the very commencement of their labours. Having anxiously watched the result of experiments made by other companies, they have for a long time entertained the hope of being able to avail themselves of great improvements in this important branch of the system. The directors conceive that it cannot fail to be highly interesting to the Proprietors to peruse a recent report upon that subject from their engineer, and they have therefore determined to submit it to them.

An adequate number of engines for the working of the line when first opened have been contracted for, and it is with pleasure that the directors have received a very general acknowledgement of approval from impartial persons, and from the public, of the alteration adopted in the width of way.

Progress is already making in the works of the two important lines connected with the Great Western Railway, that from Swindon to Stroud, Gloucester, and Cheltenham, and that from Bristol to Exeter.

It must be known to the proprietors generally, that a project has been repeatedly brought before the Legislature, for a line of seventy miles in length, from Cheltenham to Tring. In the first instance it was employed in 1835, by the opponents to the Bill for the Great Western Railway, and signally failed in its object. It was subsequently revived as a means of defeating the application for the Act for the Cheltenham and Great Western Union Railway, and after full consideration of its qualities, was rejected as incapable of competing with it in the main objects for which such a line was promoted. The peculiar excitement of the moment which procured subscriptions for any scheme, favoured the formation of a company; but the directors cannot for a moment believe that Parliament will permit the incorporation of it when they are apprised of its real objects and engineering defects, and investigate the utter insufficiency of traffic to authorize such an expenditure, especially after sanctioning the line from Cheltenham and Gloucester to Swindon.

The traffic on that line is of sufficient importance to have warranted the directors in making strong appeal, if such had been necessary, to their proprietors individually and collectively, to encourage that undertaking by every means in their power. They will hereafter be prepared, if occasion should arise, to aid or secure the completion of their works by recommending effectual assistance from the whole body of proprietors of this company.

The Bill for a short branch from Didcot to Oxford is now in the House of Commons. The traffic between that city and the metropolis will traverse sixty miles of Railway with no gradient exceeding four feet per mile in the entire distance.

The directors having balloted among themselves in manner required by the Act of Parliament, beg to announce the names of the six retiring members of the board, viz. Robert Bright, Esq.; Peter

Maze, Esq.; William U. Sims, Esq.; George Henry Gibbs, Esq.; Edward Wheler Mills, Esq.; William Tothill, Esq.; from whom their colleagues have received the declaration that they are candidates for re-election at the present meeting, for which they are duly qualified.

The usual accounts of receipts and disbursements to the 31st December last are appended to this report, with a general abstract of the expenditure, in a separate form, since the passing of the Act.

*Great Western Railway Office,*

15th February, 1837.

BENJAMIN SHAW, *Chairman.*

*Engineer's Report referred to.*

Gentlemen,—I beg to lay before you a statement of the comparative estimated expense of laying rails with stone blocks in the usual manner adopted upon other railways, and that of rails laid upon longitudinal bearers of wood, secured to a mass of concrete, or other artificial foundation, as recommended in my report of the 9th January, 1836.

In making this comparison, I leave out of consideration ballasting, as, although the quantity will be somewhat less with the timber, I think it will require more care in the forming. I have assumed 65lbs. as the weight of rail used with blocks, and the chairs and blocks at intervals of 3 feet, as I have not yet seen any good proof of longer intervals, and heavier rails being more economical. As to the price of blocks, I have taken them at our Parliamentary estimate, which is considerably below the average sum, which I understand many other companies are actually paying; but the supply of stone peculiarly adapted for blocks at the Bristol end of the line, and the facilities of communication in our case, bear out our original estimate. The iron I have assumed at 12*l.* for the rails on the old plan, and 13*l.* per ton for the rails on the new plan, and 10*l.* per ton for the cast-iron, as the present price of iron is unusually high, and may probably not last; the additional 1*l.* for the new rails is to cover the expense of planishing the surface. The plugs and keys in the one place will about balance the spikes and screws, in the timber work merely, (but not the screws for securing the rails of the other.)

The comparison therefore will stand,

<i>Blocks and Chairs—Cost per Mile—</i>				<i>Rails 40lbs. per yard.</i>			
<i>Rails 65lbs. per yard.</i>							
	£	s.	d.		£	s.	d.
204 tons 5 cwt. at 12 <i>l.</i> . .	2451	0	0	125 tons 15 cwt. at 13 <i>l.</i> . .	1634	15	0
Chairs 50 tons at 10 <i>l.</i> . . .	500	0	0	Cast-iron, 30 tons at 10 <i>l.</i> .	300	0	0
7040 blocks at 4 <i>s.</i> 6 <i>d.</i> . .	1524	0	0	Screws, &c. 20 tons at 15 <i>l.</i>	300	0	0
				Timber 360 loads at 5 <i>l.</i> . .	1800	0	0
	4535	0	0	Do. 40 do. at 6 <i>l.</i> . .	240	0	0
Difference .	539	15	0	Concrete 2000 yards at 8 <i>s.</i>	800	0	0
	£5074	15	0		£5074	15	0

The expense of laying and fixing the rails on the timber will be certainly greater than that of fixing them in the chairs; but on the other hand, the cost of moving and transporting along the line (which constitutes a material part of the cost of forming the road), of the timber will be less than the stone blocks, the weight being in the proportion of 400 to 2,200 tons. Taking every thing into consideration, and allowing more liberally for a new mode of proceeding, which I have done in the foregoing estimate, I think it would not be safe to calculate upon laying the rails upon a continuous support of timber for less than 500*l.* per mile above the cost of the ordinary rails: a result so very different from that obtained by others, who have proposed laying rails upon nearly the same principle, though not with the same detail of execution, and who have published statements showing a very great economy, instead of an increase of expense, may require some explanation, and which explanation will at the same time, I think, fully justify the incurring such additional outlay.

In many of the plans lately proposed, the object appears to be economy in the first cost; and the details of construction and even the calculation of cost are sometimes made to adapt themselves to this view.

It appears to be frequently forgotten that although lofty embankments and deep cuttings, bridges, viaducts, and tunnels are all necessary for forming the level surface upon which the rails are to be laid, yet they are but the means for obtaining that end; and the ultimate object for which these great works are constructed, and for which the enormous expenses consequent upon them are incurred, consists merely of four level parallel lines, not above two inches wide, of a hard and smooth surface; and upon the degree of hardness, smoothness, and parallelism (which last has hitherto been very much neglected), of these four lines depend the speed and cost of transport, and in fact, the whole result aimed at.

In the different main lines of railway now constructing, no expense is spared to render the earth-works and buildings of the most substantial and durable form and construction, and even of a very highly ornamental character. This liberality I believe to be judicious, but after spending 15,000*l.* and even 20,000*l.* per mile, and devoting much mind and labour to the construction of these preliminary works, it would obviously be absurd to neglect the perfection of the last step upon which every thing depends, or to sacrifice it to a paltry economy of a few hundred pounds per mile.

In forming all my plans, I have looked to the perfection of the surface on which the carriages are to run as the great and ultimate desideratum; and in the detail of construction of this last operation, without which all the previous labour is comparatively wasted, I have always contemplated introducing all the perfection of materials and workmanship of which it is capable.

This view of the subject easily accounts for the mode of con-

struction which I recommend being more expensive than some of those proposed by others, and I think my desire not to underrate the cost of any alteration of plans I recommend may account for a considerable portion of the great difference in the estimates.

With respect to the advisability of incurring such an expense, I believe you fully agree with me in my opinion of the importance of perfection in the rails; and I have no hesitation in saying, that I am confident, admitting the full difference of 500*l.* per mile to be an excess in the original outlay, that that excess will be amply repaid in the few first years of working, in the diminution of the mere cost of repair and maintenance of the way; while the gain in economy, facility, and perfection of transport, would be cheaply purchased at double the cost.

I must however repeat, that this apparent excess arises partly from a very liberal estimate of the cost of the new plan in the comparative estimate which I have made; and, if I had taken the prices which are now actually paying in some cases for rails and blocks, the balance would be the other way, while there could be no comparison (in my opinion) between the results, that is the perfection of the rail.

I am, Gentlemen,

Your obedient Servant,

(Signed)

J. K. BRUNEL.

*Statement of Receipts and Expenditure presented to the Half-yearly General Meeting of Proprietors, 16th February, 1837.*

Amount received on account of capital, to 31st Dec. 1836	721,540	0	0
Ditto, on account of interest on investments, &c.	2,891	17	4
Registration fees, &c.	386	0	0

3,277 17 4

*General Abstract.*

724,817 17 4

Expenses before the Act, to 24th

Oct., 1835, as per statement . . . 88,710 10 11

Payments to 31st Dec. 1835 . . . 4,322 1 5

„ to 30th June, 1836 . . . 92,512 9 6

96,834 10 11

*Payments, from 1st July to 31st December, 1836.*

Land and compensation . . . 136,910 11 0

Contracts for works . . . 88,556 11 6

Freehold premises in Princes-st. . . 10,103 10 0

Engineering, surveyors, &c. . . 11,628 17 2

Advertisements, printing, &c. . . 380 7 5

Travelling expenses . . . 373 2 10

Land valuers purchasing land . . . 729 4 0

Law charges, conveyancing, and

costs of title . . . 3,865 13 3

Parliamentary expenses, 1835-36 . . . 3,039 10 10

Office expenses, direction, salaries,

postages, &c. . . 2,883 5 4

258,470 13 4

444,015 15 2

£280,802 2 2

BENJAMIN SHAW, *Chairman.*

*General Abstract of Expenditure, from the passing of the Act to  
31st December, 1836.*

HALF-YEARLY STATEMENTS.												
Rendered to the } Proprietors, to }	Dec. 31, 1835.			to June 30, 1836.			to Dec. 31, 1836.			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Land and compensation . . .	2,440	10	0	61,922	10	10	136,910	11	0	201,273	11	10
Contracts for works . . .	"	"	"	15,354	12	4	88,556	11	6	103,911	3	10
Freehold premises in Princes-street . . .	"	"	"	"	"	"	10,103	10	0	10,103	10	0
Engineering, surveyors, &c. . .	"	"	"	10,769	17	8	11,628	17	2	22,398	14	10
Printing and advertisements . .	103	16	6	295	11	7	330	7	5	779	15	6
Travelling expenses . . .	108	8	2	242	2	5	373	2	10	723	13	5
Land Valuers purchasing Land . .	"	"	"	"	"	"	729	4	0	729	4	0
Law Charges, Conveyancing, and Costs of Title . . .	"	"	"	44	11	0	3,865	13	3	3,910	4	3
Parliamentary Expenses . . .	"	"	"	"	"	"	3,039	10	10	3,039	10	10
Office expenses, direction, salaries, postages, &c. . .	1,669	6	9	3,883	3	8	2,883	5	4	8,435	15	9
	4,322	1	5	92,512	9	6	258,470	13	4			
										£355,305	4	3

REPORT OF THE LONDON AND BIRMINGHAM RAILWAY  
COMPANY.

Seventh Half-yearly General Meeting of the Court of Proprietors, held Feb. 3, 1837, Isaac Solly, Esq., in the Chair.

THE directors, since their last report, have entered into contracts for the works of the stations in London and Birmingham.

At the London end of the line near Camden-Town, the company have about thirty-three acres of land, intended as a depot for the buildings, engines, waggons, goods, and various accessories of the carrying department of the railway. At Euston Grove they have a station of about seven acres for the passenger traffic, and both stations are connected by the extension line. Passenger trains are to be moved on this portion of the railway, by a stationary engine in the Camden depot, and locomotive engines are to be employed on every other part of it. At the Birmingham end of the line, the company have a station of about ten acres, which will serve both for passengers and goods. The arrangement of these stations, and the plans for the necessary buildings

and machinery connected with them, have been maturely considered, and the contractors are under penalties that the various works in London shall be completed by June next (with the exception of the façade of the Euston station, for which three months more are allowed), and the works in Birmingham by November next.

The entrance to the London passenger station, opening immediately upon what will necessarily become the grand avenue for travelling between the metropolis and the midland and northern parts of the kingdom, the directors thought that it should receive some architectural embellishment. They adopted, accordingly, a design of Mr. Hardwick, for a grand, but simple portico, which they consider well adapted to the national character of the undertaking.

The plans and specifications of the buildings at the intermediate stations are in progress, and the whole of this portion of the work will be completed against the opening of the railway.

The greater part of the locomotive engines required to convey the trains of passengers and goods, and of the necessary carriages of all descriptions, are also contracted for, and will be delivered in succession, as they are required to meet the wants of the company.

The directors, in their late reports, expressed an expectation that the first twenty-one miles of the railway from London, would be completed in the spring of 1837. They regret to say, that, owing to the late unexampled season, this expectation cannot now be realised before the summer. The engineer reports that the continued bad weather for the last four months, defeated his calculations in a degree which no former experience could have led him to anticipate. In some descriptions of soil, this delay could not have taken place to such an extent as in the London clay, which is exemplified by the progress of the works on other parts of the line, where the material is more favourable; but in the London district, the incessant falls of rain have rendered it quite impracticable to proceed with them uninterruptedly. With the excavations and embankments on the Primrose-hill contract, he persevered until the extra expense was such as to induce him to suspend further operations; a step, in the propriety of which, the directors fully concurred.

The preceding remarks apply especially to the works of the embankments at the Brent, Tring, and the Wolverton Valley; all the minor works, however, have necessarily been affected in a similar way, though in a less degree; but as this delay does not interfere with the contemplated opening of the first twenty-one miles of the railway, it is unnecessary to remark upon them more particularly.

The works of the Extension Line require but six weeks of fair weather to complete them.



The works of the Primrose-hill contract, which have been continued by the company, under the direction of the engineer, are nearly completed, with the exception of the Brent embankment. The Primrose-hill and the Kensal-green tunnels are finished, and traversed by the company's engines, and the permanent way is laid through a great part of this contract. Of the embankment on the south side of the Brent bridge, about 58,000 cubic yards remain unfinished, to complete which, under an ordinary state of the weather, would require three months. That portion of the embankment which is north of the bridge is brought up to it, but not yet raised to the railway level. On the completion of the embankment north of the Brent, the engineer proposes to expedite the formation of the south portion of it, by making 6,000 or 8,000 cubic yards of side cutting, thus guarding against further disappointment as far as practicable.

From this point to Watford, no work appears to require especial mention, the completion of the Watford tunnel, and the small quantity remaining in the excavations at each end, rendering any detailed remarks on this part of the line unnecessary.

The state of the three succeeding contracts is in general satisfactory, and the engineer reports that, with tolerable weather and a continuance of the same activity on the part of the contractors that they have hitherto displayed, the works may be completed, and the line opened to Tring in the autumn. The North Church tunnel is already finished.

The quantity of water yielded by the cutting, in addition to that which has fallen in rain, together with the argillaceous character of the chalk in the Tring contract, rendered it absolutely necessary to stop proceedings on the embankment, and to confine them to the side cutting and spoil. It is but justice, however, to the contractor, to add, that he persevered in carrying on the embankment, until the engineer reported that it became positively impassable. Notwithstanding this temporary delay, the engineer is of opinion that the completion of this contract will certainly not be much protracted beyond October next.

By a new apportionment of the Wolverton embankment between the two contractors, the works will henceforth proceed satisfactorily.

The Blisworth works being now in possession of the company, by agreement with the contractor, all the skill of the engineers, and the pecuniary resources of the company, will be exerted to recover the time lost, as upon these works will depend the opening of the whole railway.

Two lengths of the quicksand portion of the Kilsby tunnel have been completed, and the work there now assumes the ordinary character of tunnelling.

With respect to Blisworth, the engineer-in-chief reports, that arrangements are being made, by which it may be carried on with the utmost expedition; "the rate of progress will depend in a

great measure on the quantity of water, and the character and precise extent of the rock, which has to be underset by masonry."

Respecting Kilsby, Mr. Stephenson states, that "unless a very unexpected quantity of water should be found, where at present no sign of it exists," we may reckon upon this tunnel being opened "from end to end in about seventy weeks."

The line between Birmingham and Rugby, will probably be completed before the end of the year; and, as Mr. Stephenson states, "that after a careful investigation of the Kilsby and Blisworth contracts, and duly weighing the probable contingencies attendant upon the execution of such works," he is of opinion that *"they may be completed in the summer of 1838, and that consequently the whole railway may be opened at that period;"* the directors have every reason to rely on the fulfilment of the expectations on this head, which, in their successive reports have been held out to the proprietors.

The directors took occasion in their last report to congratulate the proprietors on their anticipated accession of traffic from other railways, and amongst the number from the Derby and Birmingham, which was to join the London and Birmingham Railway at Birmingham, and at Stone Bridge. They have since learnt with regret, that a Bill is to be brought into Parliament by the Derby and Birmingham Company, for powers to carry their line from Tamworth to Rugby, instead of to Stone Bridge; and that a Bill is also to be brought into Parliament by another company, to continue the line from Tamworth to the neighbourhood of Stafford, thus intercepting from the London and Birmingham Railway for the distance between Birmingham and Rugby, a considerable portion of traffic on which this company had every reason to rely. The directors, therefore, in compliance with the declared wishes of the proprietors, have made known their intention of opposing what they must look upon as competing lines.

The House of Lords having declared in the last session of Parliament, that the Cheltenham, and Oxford, and London, Birmingham Union Railway is not a "competing line," the directors, in the conviction that the proposed communication will be of great importance to the company, and in compliance with the wishes of the proprietors, have decided to give it all the support they can.

The directors were in hopes of seeing an efficient railway communication furnished to the population of Warwick, Leamington, and Kenilworth, by means of a branch, communicating with the London and Birmingham Railway, near Coventry. The intermediate country was surveyed, and a committee, consisting of influential parties in that neighbourhood, formed for the purpose of carrying the object into effect. The directors regret, however, to say, that notwithstanding the pains that have been taken to select a line which should be unobjectionable to the landowners through whose property it was to pass, the great majority of them are at present opposed to any practicable line, and the project has,

therefore, been abandoned for the present, but the directors will be glad at any future time, when, as they hope the objections to the landowners may be removed, to give all the support they can to this desirable undertaking.

The directors have made a satisfactory arrangement with the directors of the Birmingham, Bristol, and Thames Junction Railway Company, for the conveyance of the traffic of this company upon their line, when required.

By the statement of account [A] now to be laid before the proprietors, it will appear that—

The receipts to the 31st December, were	£ 2,380,209	13	9
The disbursements	£ 2,285,321	2	5

That the balance in favour of the company

was at that date . . . . . £ 94,888 11 4

The proprietors, in referring to these accounts, will observe that the original capital of the company has been expended within £ 214,679.

The directors have been enabled, as the work approached completion, to prepare estimates [B] which show that the contemplated works for the efficiency of the railway in the carrying department, as well as for the road itself, will require a sum of nearly one million more, and that the total outlay will probably reach four and a half millions.

This additional cost arises—

- 1st. From additions, alterations, and extras to the original plan of the works.
- 2d. From the extension line to Euston Grove.
- 3d. From the additional quantity of land (800 acres), and the much higher price the company have been compelled to pay than was at first estimated, a price in some degree extorted by the necessity of obtaining possession at an earlier period than by the provisions of the Act of Incorporation the Company could legally enforce.
- 4th. From the increased prices which it has been found necessary to give for all the materials composing the permanent way, such as rails, blocks, &c., as well as from the additional weight of the rails, chairs, &c., which experience has shown it to be prudent to use, and from the greater expense of conveying these materials to their destination, than was anticipated.
- 5th. From unforeseen difficulties in the Primrose Hill, the Blisworth, and Kilsby Contracts.
- 6th. From the ample provisions made for the carrying department, and particularly with reference to the traffic to be expected from other railways, for which Acts have been obtained since the estimate was made.

On the whole, however, the directors have reason to believe, that by this additional outlay, the railway will prove much more equal to the work it will be called on to perform in the conveyance

of the immense traffic to be expected; and that the cost of the wear and tear, and annual repair will be correspondingly less, in consequence of the greater strength and solidity given to the works.

*General Statement of the Receipts and Disbursements of the London and Birmingham Railway Company, to 31st Dec., 1836. [A]*

RECEIPTS—DEC. 31, 1836.

	£	s.	d.	£	s.	d.
CALLS . . . . .	1,728,796	18	3			
Paid in advance on shares	21,595	2	0			
				1,750,392	0	3
LOANS.—At Four per Cent.	560,061	5	0			
At Four and a Half per Cent.	49,300	0	0			
				609,361	5	0
MISCELLANEOUS RECEIPTS,						
viz:—Penalties . . . . .	1,505	0	0			
Land re-sold and rents . . . . .	794	12	5			
				2,299	12	5
INTEREST, viz:—Exchequer						
bills and bankers' balances	16,818	8	6			
Calls in arrear . . . . .	1,338	7	7			
				18,156	16	1
				£2,380,209	13	9

DISBURSEMENTS—DEC. 31, 1836.

Amount, as per statement annexed . . . . .	2,285,321	2	5
Balance at the disposal of the company . . . . .	94,888	11	4
	£2,380,209	13	9

*Statement of Disbursements to 31st December, 1836.*

For obtaining Act of Incorporation . . . . .	72,868	18	10
Land and compensation . . . . .	579,499	11	5
Conveyancing . . . . .	6,328	3	4
Contracts for works . . . . .	1,534,275	19	3½
Engineering . . . . .	49,654	11	3½
Law charges . . . . .	5,006	9	10
Advertising and printing . . . . .	2,611	2	5
Direction . . . . .	7,341	2	6
Office charges, salaries to secretaries, &c. . . . .	15,080	12	4
Sundries, travelling charges, &c. . . . .	5,392	11	3
Interest on debentures . . . . .	5,022	17	11
Stamps . . . . .	2,239	2	0
	£2,285,321	2	5

R. CREED, }  
C. R. MOORSOM, } *Secretaries of the Board.*  
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*Estimate of the Cost of the Railway to the Time of Completion,  
compared with the Parliamentary Estimate. [B]*

	Present Estimated Cost.	Parliamentary Estimate	Excess.
Land and Compensation .....	506,500	250,000	256,500
*Contract Works for forming the Road ..	2,146,068	1,703,830	442,238
† Rails, Chairs, Blocks, Sleepers, and incidental Charges .....	693,822	366,977	326,845
Stations and Carrying Department :—			
Buildings .....	£154,521		
Locomotive Engines .....	100,215		
Carriages, Waggon, &c. ..	153,500		
	408,236	80,000	328,236
General charges :—			
Expenses of obtaining Act of Incorporation .....	72,869		
Law Proceedings, including Expenses of Amended Acts .....	12,000		
Conveyancing .....	53,800		
Engineering and Surveying .....	127,100		
Direction .....	13,300		
Office Charges, Salaries to Secretaries, &c. ....	27,515		
Printing and Advertisements .....	4,800		
Sundries, including Travelling Charges, and all other Expenses .....	10,600		
	321,984	99,191	222,791
Euston Extension (including Passenger Station) .....	4,076,610	2,500,000	1,576,610
	255,722		
	4,332,332		
Interest on Loans .....	144,262		
Total Estimated Cost .....	£ 4,146,594		

R. CREED,  
C. R. MOORSOM, } *Secretaries of the Board.*

(Notes.)

- \* **WORKS IN FORMING ROAD.**—The engineer states,—  
That owing to an increased width in the railway, increased slopes, and increased dimensions of several of the turnpike road and canal bridges, his revised estimate exceeded the Parliamentary estimate by £ 110,240  
That the whole of the contracts were let below the revised estimate;  
That the excess of expenditure chiefly arises in the following contracts, viz :—

1. Primrose-hill, about six miles in length, including the Primrose-hill tunnel ;
2. Blisworth, about five and a half miles ;
3. Kilsby tunnel ;

which were thrown on the company's hands, in consequence of the great and unforeseen (and in the cases of the Primrose-hill and Kilsby tunnels, unprecedented) difficulties which occurred in the progress of the works, and that this excess may be thus apportioned :—

1. <i>Primrose-hill Contract</i> .—Additional outlay from the extremely disadvantageous circumstances under which the company were compelled to take up the contract	21,636
Ditto in new roads, bridges and sewers, required by diverting existing roads through Camden-Town depot, and on other parts of the contract	21,552
Ditto in additional strength necessary to the two tunnels, from the peculiar nature of the London clay	34,151
	<hr/>
	83,339
2. <i>Blisworth Contract</i> .—The additional outlay required to make good the loss of six months of time, and also for the completion of the costly parts of the works which have fallen to the company to execute	60,000
3. <i>Kilsby Contract</i> .—The occurrence of an extensive bed of quicksand lying over nearly one-fourth of the whole length of tunnel, and requiring to be drained by powerful steam-engines, which must be kept at work till the completion of the contract; the other parts of the tunnel abounding in water, and rendering it necessary to increase the number of shafts to an extent which could not have been foreseen	140,000
Extras on the remaining contracts	48,659

† RAILS, CHAIRS, &c.

The increased weight of rails, and the rise in the price of iron, have caused an excess of	258,000
The additional price of blocks, sleepers, &c., and incidental charges thereon, above the estimate	21,485
The number of stations on the line more than contemplated, and the consequent addition of rails, blocks, &c.	47,000

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**£326,845**

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The excess of expenditure for land and compensation, and for the carrying department, is accounted for in the Report.

R. CREED,  
C. R. MOORSOM, } *Secretaries of the Board.*

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#### BRISTOL, BIRMINGHAM, AND THAMES JUNCTION RAILWAY.

WE are glad to hear that the directors of this line have commenced operations with a spirit and vigour which show that they are in earnest, and do not intend to rest satisfied with having obtained their Bill, but are determined to go right through with the undertaking, in order to give their constituents the quickest possible benefit of it.

The works, for the formation of this railway, were commenced on Feb. 6th, at Wormwood Scrubbs, at the point where it passes under the Grand Junction Canal, which will be relieved from the awkward bend there now is, and will be made perfectly straight: the works are being prosecuted vigorously.

Advantageous arrangements have been made, by the directors, with the London and Birmingham, and Great Western Railway Companies, for the interchange of traffic at the points of junction of the railway, and also with the Grand Junction Canal Company, for the purpose of conveying their goods to the Thames by means of the Kensington Canal, which this Company has purchased. Plans have been submitted to, and approved of, by the Grand Junction Canal Company, for the formation of an extensive wharf upon the banks of that canal where the railway crosses it.

The Kensington Canal will be immediately cleansed and deepened by this Company, and the tolls derived from the traffic already existing upon it will become available to the Railway Company.

A Bill has been brought into Parliament for an extension of this line to Knightsbridge-green, from its present terminus at Kensington. This extension will be most important in every point of view. Mr. Clay has charge of the Bill, and there is every prospect of its passing without opposition.

We much approve this plan, and think it will tend greatly to relieve Piccadilly from the crowd and confusion that would ensue if the terminus was much nearer. From this point the traffic may radiate off to the north and south with little interruption; and if a market be made at Knightsbridge, as contemplated by another company, the benefit to the western environs of London will be incalculable.

## RAILWAY NOTICES.

A locomotive steam engine, on a new plan, for common roads, has just been built at Brussels, whence it will be immediately brought to Paris. It is said to be exempt from the usual inconvenience of steam carriages.—*Hampshire Advertiser*.

A Calcutta journal mentions, that a scheme for railroads, from the Mount and from Poonamalle, to Madras, had received the sanction of Government, and that the plan was to be carried into effect forthwith.—*Times*.

*Brighton Railways*.—We understand Stephenson's line opposes Mills's in the standing orders, and the inquiry is fixed for Tuesday, the 28th.

*Birmingham Railway*.—Great gloom has been thrown over the share market, by the announcement that this Company will want two millions more money than the estimate. Was not this the Company that some year or two back were, week after week, and month after month, trumpeting forth that such a contract had been made which exactly agreed with the engineer's estimate; that a second was finished some few thousands less than the engineer computed; a third still less, &c. &c.? If all this was true then, how comes it about now, that the whole capital, instead of being quite enough, or too much, is found to be no less than eighty per cent. too little, that is little more than half what it ought to be? We think we have a prospectus in which are these emphatical words, "The cost will be 2,500,000*l.*, and the SUFFICIENCY of this estimate has been ascertained by the Committee of the House of Commons, upon the TESTIMONY of Mr. STEPHENSON, supported by TWO OTHER EMINENT ENGINEERS." What answer can be given to this?

But to be serious, the allowance for contingencies was in this estimate, no less than 294,648*l.* Thus, then, stands the account—

Engineer's Estimate . . . . .	£2,205,352
Do.'s error . . . . .	2,294,648

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Total cost . . . . . £4,500,000

But it may be 5,000,000*l.*, making the trifling error of 2½ millions on 2½!!!

Would it not now be better to abandon this line, with its nine tunnels, and take up Sir John Rennie's, which has only one, and which would cost about one-fourth of the amount, or little more than the second additional sum now wanted. If as stated in the Report, they have spent only 2,280,000*l.*, and have had in cash unpaid shares, and money already borrowed 3,400,000*l.* they will have about enough to make, as we understand, Sir John Rennie's new line, without borrowing this other million. The tunnels might be converted into dark holes for the punishment of culprits, or



would make very excellent gypsy retreats, cow-sheds, pig-sties, &c. &c. We recommend the directors and shareholders to take this into their serious consideration, and they will, no doubt, make us a handsome compliment for the suggestion.

Is it true, as whispered about, that a great portion of this new sum wanted has been spent in buying off opposition, &c?

Why, this line will cost upwards of 40,000*l.* a mile! or more than double the average cost. Surely this is a second edition of the Liverpool and Manchester Railway, which, if we recollect right, Mr. Stephenson undertook to make for about 500,000*l.*, but which in reality has, we believe, cost near three times the amount! For the shareholders' sakes, and for the sake of burying in oblivion Mr. Stephenson's sad, sad blunder, we hope the success of the one may equal that of the other.

*Coal in India.*—An extensive bed of coal has recently been discovered in the Saugur district, and of a quality superior to any that has ever before been found in India. The position of the field is about twelve miles south of the Gurrawarre, at the foot of the hills.—*Globe.*

*Doncaster, North Midland, and Goole Railway.*—A formidable opposition is threatened to this line from the landed interest.

*Eastern Counties Railway.*—We are exceedingly sorry to see the correspondence which has been published between the secretary of this company and Lord Petre. Had invention been taxed to blast the character of a company, and to throw a deep shade over the honour of other companies, it could not have contrived a more effectual means than this stupid correspondence, and the still more stupid publication of it, have. The facts, it seems, are exactly as stated in our last; namely, the company pledged themselves not to go through Lord Petre's lands, and if they did, they entered into a bond to pay him 20,000*l.* for the lands taken, and "100,000*l.*!!! as compensation for the injury" done. That such an agreement ought never to have been made, is clear from the manner in which it is attempted to be evaded. It was, therefore, either entered into on good faith to be kept, or it was not. From the letters of the secretary it appears it was not intended to be kept; for he talks of "*penal sums*," which we suppose mean trickery and deception. But the worst is yet to come. "In answer to your letter," says Lord Petre, in a note to the secretary, "I have only to say, the **ASSERTIONS YOU MAKE IN IT ARE NOT FACTS.**" This most serious charge is again repeated, but in other terms, by Messrs. Few and Hamilton, Lord Petre's solicitors. We presume the directors must be deeply indebted to Mr. Robertson for these glittering honours, these brilliant fruits of his *cacoethes scribendi*. To admit a breach of faith, and then to be taxed with deliberate falsehood (for that is the plain English of the matter), are distinctions every secretary cannot procure for his directors. Are they worth 800*l.* per annum? But we want to know what is to be done

with the injunction and the 120,000*l.* That it must, and ought in honour to be paid, there can be no doubt; but how will the shareholders like it?

*Great North of England Railway.*—The half-yearly general meeting of the Great North of England Railway Company was held at the company's office, in Darlington, on Wednesday the 1st instant. G. H. Wilkinson, Esq., the chairman of the company, read a highly-satisfactory report to the shareholders, the principal points in which were, that extensive contracts for land in the county of Durham have been effected, and that considerable progress has been made in friendly negotiations for land both in the county of Durham and in Yorkshire; that the contracts for fencing the second divisions of the way are concluded, and advertisements issued for the supply of stone blocks, and for the erection of that magnificent work, the Shincliffe Viaduct, and that tenders for the formation and completion of the second division of the line had been received, and were under consideration, and that the whole of these contracts are expected to be made in the course of the present month. It was further stated, that from the friendly spirit manifested by the landowners in Yorkshire, no doubt was entertained of obtaining, in the present session, the Act for carrying forward the line to York, in conformity with the original intention of the subscribers. A petition, in favour of the extension, was then read and approved, and it was unanimously agreed to request Joseph Pease, jun., Esq., M.P. for South Durham, and the Hon. W. Duncombe, and E. S. Cayley, Esq., the representatives for the North Riding, to take charge of the Bill in its progress through the House of Commons.—*York Herald.*

*Greenwich Railway Hoax.*—A most vile hoax has been played off on several respectable Morning Papers, no doubt by some mischievous imp of the Stock Exchange. It has been stated that the whole concern had been seized by an execution at the suit of Mr. Macintosh, the contractor, for a debt of 300,000*l.*!!! We hope the papers can identify the author, whom it would be gratifying to see soundly ducked in the Croydon Canal, and then carried daily on the top of one of the engine-chimneys for a week backwards and forwards every journey, that the fellow may see and be seen.

*Greenwich Railway.*—This line is beginning now to tell its own tale in the current coin of the kingdom. We have all the daily returns during the months of December and January, and have seen those of February to the present moment, the 22d. The average daily receipts are rising rapidly. The greatest amount taken in one day, during December and January, was 135*l.*; the greatest in the present month, exceeds 200*l.*, which is at the rate of 73,000*l.* per annum, or above 12 per cent. on the capital, supposing it 600,000*l.* And if one-third (which is more than it can be for a mere passenger traffic) was taken for wear and tear and other expenses, it would leave 8 per cent. profit. Now it does

appear highly probable that this line, when completed to Greenwich, will average this profit from its own proper carrying returns, independent of any other source of profit whatever.

*Great Western Railway.*—We refer our readers to the report of the directors for very full and satisfactory information on this great undertaking, and to Mr. Brunel's, for some valuable and interesting matter and improvement. Notwithstanding the great rise in labour and materials, and a more expensive (to insure a much more perfect) execution of the work, the estimate is positively stated to be within 400,000*l.* of the amount wanted. This is something less than 2,000,000*l.* on the Birmingham estimate.

*Irish Commission.*—Charles Vignoles, Esq., has been appointed engineer to the above commission, which is proceeding to lay down a stable and useful system of railways for Ireland.

*Limerick and Waterford Railway.*—In our last number we slightly alluded to this proposed railway. We have, since, perused Mr. Smith's pamphlet on the subject, and think he has made out a very clear case of the advantages and profit of this line. Its length is 75 miles, the estimate cost 1,000,000*l.*, or little better than 12,000*l.* per mile, and gross revenue 166,174*l.* Mr. Smith makes the expenses only 60,000*l.* Here we must beg to differ. We think from looking over the kind of traffic that the expenses of working and keeping the line in repair, will be more nearly 80,000*l.*, leaving about 86,000*l.*, or eight and a half per cent. profit. But we presume this will be quite enough to satisfy any reasonable man.

*London, Exeter, and Falmouth, and the South Western Railways.*—It is said these two rival companies have very lately come to an understanding, not to waste their shareholders' money in Parliamentary warfare. We are glad to hear this. It shows good sense on both sides.

*Newcastle, Edinburgh, and Glasgow Railway.*—The project of a railway communication between Newcastle-upon-Tyne, Edinburgh, and Glasgow, by the Midland line of road, begins to engage the serious attention of the public, as offering a desirable investment for capital.—*Newcastle Journal.*

*Railway between Newcastle and Morpeth.*—At a numerous and respectable meeting of the inhabitants of Morpeth, held in the Town Hall, on Tuesday last, R. Blakey, Esq., (the Mayor) in the chair, it was resolved to form a company, for the purpose of carrying into effect a communication by railway between Morpeth and Newcastle.—*Tyne Mercury.*

*Newcastle and North Shields Railway.*—The first annual general meeting of this company was held at the Assembly Rooms, on the 24th January, M. Bell, Esq., M.P. (chairman of the directors), in the chair. The report of the directors gave a very favourable account of the state and progress of the undertaking. The accounts of the company were next read, and showed that the

calls had been nearly all paid. On the motion of Mr. C. J. Joblin, seconded by Mr. J. Clayton, it was resolved that the report should be adopted, and, with the accounts be printed and distributed to each proprietor.—*Tyne Mercury*.

*Northern and Eastern Railway Company*.—An advertisement which appears in our present number, relative to the above railway, affords us an opportunity of putting our readers in possession of the facts relating to it.

The original project was, to carry this railway from London to York, by the way of Cambridge; but, in the last session of Parliament, the promoters of the undertaking applied only for that portion of it which extends from London to Cambridge. We think this was wise. Two hundred miles of railway strike us as too much to attempt at one time. The line from London to Cambridge is not too large in respect to the magnitude of its works, or capital required. We observe from the advertisement, that the directors have adopted the resolution of keeping distinct, as to their subscriptions and profits, the two lines from London to Cambridge, and from Cambridge to York. This determination, in our opinion, is judicious. The line from London to Cambridge is, perhaps, sufficient for one concern, and if it will pay 14 per cent., which the promoters think it will, there is no necessity for joining the other part to it. Besides, there is little doubt but the portion nearest the metropolis will pay the best. Moreover, the Act of the one is obtained, for the other it is not; and though we have no doubt, that a railway communication will be formed between Cambridge and York, this is not the time to set on foot new speculations. At the half-yearly meeting of the company, held a few days ago, the above course was unanimously approved by the proprietors, as well as the intention of the directors announced in the report to commence the execution of the works as early as the necessary preliminary proceedings, for getting possession of the land, would admit. The works are to be commenced near Kingsland-turnpike, and thence to be completed to Cambridge, before attempting to bring the railway nearer to the heart of London. This determination we much approve, and would counsel them to make their London terminus at some spot near Kingsland-turnpike. It is quite near enough for all the purposes of their railway; and would save their proprietors a great outlay of capital.

*Railway Switches*.—Mr. Rooke, dancing master, of Botcherby, near this city, has invented a method by which the engine performs the work of putting the switches right itself, and in whatever direction the engineman wishes to travel.—*Carlisle Journal*.

*Southampton Railway*.—The directors and officers of this company are prosecuting the works with a zeal and economy highly creditable to them. While they are resolved to avoid meanness, they seem determined to shun extravagance in every

shape and form. We find by their report that they will want half a million more than their Act empowers them to raise, or in the whole, 1,800,000*l.* If they can accomplish their object for so small an addition to the first close-shaving estimate, and with so many disadvantages in the rise of materials and labour against them, we expect they must have made good use of their money.

*Railroads in Egypt.*—His Highness Mehemed Ali has just ordered the commencement of a railroad for the transport of stone at Tourab, a place six miles to the south-east of Cairo. This railroad will be upwards of five miles in length, running from the Mokatam mountains to the Nile. The Suez railroad has not yet been commenced.—*Mining Journal.*

*The Tamworth and Rugby Railroad.*—At a numerous and respectable meeting of the landowners on the line of the proposed Tamworth and Rugby Railway, it was resolved that the projected railway was uncalled for on public grounds, and an unnecessary interference with, and violation of, the rights of private property, and it was, therefore, determined to give it a decided opposition in Parliament.—*Liverpool Times.*

*Railway from Whitehaven to Maryport and Carlisle.*—At a meeting of the Committee of the contemplated railroad, Whitehaven to the Maryport and Carlisle, held at the former place, three plans were laid before the meeting by Mr. Hall—two interior, or inland lines, and one along the coast by Parton, Harrington, across the Cloffocks at Workington, and thence along the shore until it forms a junction with the Maryport line. The interior lines Mr. Hall characterised as all but impracticable—the rise being immense, and the curves both numerous and too sharp for railway travelling. The coast line is straight and easy of accomplishment, and its formation will not by any means be so expensive as was originally contemplated. The distance does not exceed eleven or twelve miles. This line was agreed upon, and the necessary documents to enable an application to Parliament next session, will be prepared forthwith.—*Cumberland Packet.*

## PARLIAMENTARY PROCEEDINGS.

Petitions for Bills up to Friday night, inclusive.—57 Petitions for new Bills and alterations had been presented; 25 have been read a first time; and 15 a second time; namely,

Brighton, Lewes, and Newhaven, first time, February 13; a second, Feb. 21.—Cheltenham, Oxford, &c., a first time, Feb. 21.—Chester and Birkenhead, first time, Feb. 20.—Chester and Crewe, first time, Feb. 21.—Clarence, (Durham) first time, Feb. 21.—Commercial, first time, Feb. 16; second, Feb. 24.—Grand Connexion (Worcester and Wolverhampton), first time, Feb. 20.—

Great Western (Paddington), first time, Feb. 14; second, Feb. 22.—Great Western, (Trowbridge), first time, Feb. 14; second, Feb. 22.—Lancaster and Preston, first time, Feb. 15; second, Feb. 24.—Liverpool and Manchester, first time, Feb. 15; second, Feb. 24.—London and Brighton (Rennie's), first time, Feb. 15; second, Feb. 21.—London and Brighton (Stevenson's), first time, Feb. 15; second, Feb. 21.—London and Brighton (Gibbs's), first time, Feb. 24.—Manchester South Union, first time, Feb. 15; second, Feb. 24.—Manchester and Leeds, first time, Feb. 14; second, Feb. 22.—Manchester, Cheshire, and Staffordshire, first time, Feb. 24.—North Midland (Leeds and Derby), first time, Feb. 15; second, Feb. 24.—Oxford and Great Western, first time, Feb. 14; second, Feb. 22.—Sheffield and Manchester, first time, Feb. 22.—South Eastern London and Dover, first time, Feb. 17.—Southwark and Hammer-smith, first time, Feb. 15; second, Feb. 24.—Taff Vale (Merthyr Tydvil), first time, Feb. 15; second, Feb. 24.—Whitby and Pickering, first time, Feb. 16; second, Feb. 24.—York and North Midland, first time, Feb. 22.

The particulars for which these Bills were read are to be found in No. 11, pp. 9, *et suis*.

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*Feb. 1.*—Mr. Gillon gave notice that on Monday, the 21st of March, he would call the attention of the House to the state of internal communication in the country by roads, canals, railways, &c., and the cost of these to the public.

*Feb. 21.*—Lord G. Somerset presented a petition signed by 1,400 inhabitants of Brighton, praying the House to consider the various projected lines to Brighton, and to pass that one most likely to give the greatest amount of actual benefit.

*Feb. 22.*—Mr. Warburton presented two petitions, one from three owners of land\* in Kent, alleging that the Kent Railway Company had got men of straw to sign their deed, and that certain small sums had been paid for so signing—the other from some who had signed praying to be relieved from a responsibility they affected to dread, and pretended they had not known. A committee to inquire into the allegations was to be named next day, but it was put off until March 1st.

\* In so grave an inquiry as this, and where a large company, capital, and gentlemen of high respectability, are to be affected, we hope these "owners of land" will turn out to be men whose station in society and character will bear a strict and rigid scrutiny.

# PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on									
					Jan.		February.							
					31.	3.	7.	10.	14.	17.	21.	24.		
			£.	£.										
9,500		(3) Birmingham and Derby .....	.....	5	6	5 $\frac{7}{8}$	10 $\frac{1}{2}$	10						
7,500	.....	(3) Birmingham and Gloucester .....	.....	10										
	.....	(2) Birmingham, Bristol, and Thames Junction .....	20	2										
15,000	.....	(3) Bristol and Exeter .....	100	5			2	.....	.....	2	1 $\frac{1}{2}$	1		
660	.....	Calcutta and Saugar .....	50	2										
350	.....	Cheltenham .....	100											
7,500	.....	(3) Cheltenham and Great Western .....	100	7 $\frac{1}{2}$										
14,000	.....	(4) Cheltenham, Oxford, and Tring .....	100	5				2 $\frac{1}{2}$	.....	.....	2			
2,000	.....	(2) Clarence .....	100	100										
12,000	.....	(3) Commercial Blackwall .....	50	2	$\frac{3}{8}$	.....	.....	$\frac{1}{2}$	.....	.....	$\frac{1}{2}$	2 $\frac{1}{2}$		
8,000	.....	(4) Dublin and Kilkenny .....	100	2 $\frac{1}{2}$	2 $\frac{3}{4}$	.....	2 $\frac{3}{4}$	2 $\frac{1}{4}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$			
7,500	.....	(4) Durham South-West Junction ..	20	3										
60,000	.....	(3) Durham Junction .....	100	10										
	.....	(3) Eastern Counties .....	25	2	1 $\frac{3}{4}$	.....	.....	1 $\frac{3}{8}$	1 $\frac{5}{8}$					
5,000	.....	Edinburgh and Dunbar .....	.....	2										
13,000	.....	(3) Edinburgh, Leith, and Newhaven	20	1										
800	.....	(4) Edinburgh and Glasgow .....	50	2							3 $\frac{5}{8}$			

[illegible]



# PRICES OF RAILWAY SHARES (Continued).

Closing Price of Shares in London Markets on														
Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	February									
					Jan. 31.	3.	7.	10.	14.	17.	21.	24.		
			£.	£.										
15,000	.....	(3) Midland Counties .....	50	5	15½	.....	14	.....	14	13½	12¾	12		
		(3) North Midland .....	100	10	3½	.....	3	2½						
		(3) Northern and Eastern.....	100	6										
2,500	.....	(2) Preston and Wigan.....	.....	20										
2,600	.....	(2) Preston and Wyre .....	50	18										
4,000	.....	(3) Sheffield and Rotherham .....	25	6										
1,000	6d. per c.	(1) Stockton and Darlington .....	100											
1,500	.....	(2) Stanhope and Tyne .....	100	100										
3,000	.....	(4) South Durham .....	50	2½										
28,000	.....	(3) South-Eastern and Dover .....	.....	7	6¾	.....	5¾	5½	.....	.....	.....	.....		
24,000	.....	(4) Do. Brighton, Lewes, and Newhaven .....	50	2	2½	2¼	2¼	2	1½	¾	1¾			
		(4) South Midland .....	50	1	.....	.....	.....	.....	.....	.....	.....	.....		
40,000	.....	(4) South-Western (Stevenson's) ...	50	1	.....	.....	1½	.....	.....	.....	.....	.....		
9,000	.....	(3) Thames Haven .....	50	2½										
6,600	.....	(4) Victoria .....	25	1	.....	.....	.....	.....	.....	.....	.....	1½	1½	
1,400	.....	(4) Westminster and Greenwich .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	
6,000	.....	(3) York and North Midland .....	50	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of  $\frac{1}{4}$  in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

# THE RAILWAY MAGAZINE;

AND  
*Annals of Science.*

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No. XIV.

APRIL, 1837.

NEW SERIES.

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*Of the Resistance of Locomotive Engines in use on Railways.* By M. DE PAMBOUR, translated from the Account read at the Royal Academy of Sciences, 27th Feb., 1837. With Notes, BY THE EDITOR.

(Commissioners MM. Biot, Arago, Poncelet, Coriolis.)

"THE object M. Pambour proposes to himself is to determine the passive resistance of locomotives with or without a load,\* and then to analyze this effect so as to be able to recompose it *a priori* for any machine whatever, according to its proportions, its weight, and that of its load.

"For this purpose the passive resistance of isolated locomotives is at first determined by direct experiment, made according to three different ways, of which one is by the dynameter, and two others by methods peculiar to the author; namely, that of the least pressure which consists in finding what is the least pressure of the vapour capable to maintain the engine in motion along the rails; and that of the angle of friction, which consists in abandoning the machine to itself on a system of two inclined planes on the Liverpool Railway, one after the other, the former being more and the other less inclined than the angle of friction, and then, calculating the resistance of the engine, by comparing the height it has fallen through, with the

\* The Author calls the passive resistance the force which the machine expends to keep itself in motion; that is, the force which must be applied along the rails to overcome the friction which is opposed to its progression at the instant in which it executes the traction of the train. Between the resistance and the friction he makes a distinction: the friction is a force exerted and measured at the place itself where the rubbing parts are in contact, the resistance is the definitive effect of this friction against the progress of the machine; that is to say, a force always measured by the traction that must be applied along the rails to overcome it. The resistance in question of the machine is then of this latter nature.

space it has run on the planes. In this computation, account is taken of the resistance of the air against the motion. (See Note A.)

"It results from experiments made on nine different machines, that a locomotive of eight tons, and four wheels uncoupled, has a mean passive resistance of 106lbs.; and that a machine of  $12\frac{1}{2}$  tons, and four wheels coupled has a passive resistance of 145lbs.

"These results respect the resistance of isolated engines, or without any load; but the load increases considerably the friction, and consequently the resistance peculiar to the engines.

"To arrive by theory at the knowledge of this increase of resistance in virtue of the load, the author divides the resistance of locomotives into three parts, namely, the resistance due to the weight of the engine considered as a carriage, the resistance due to frictions of its machinery, taken separately from the load, and the additional resistance due to the effect of the load on the joints of the machine. (See Note B.)

"This last effect, submitted to calculation, conducts to a general formula, by means of which one may determine the additional resistance produced by each ton of load in any engine of which the dimensions are given.

"This formula contains two terms, one relative to the friction of the sliding parts (tiroirs), where we know that the resistance which results from them against the progress of the engine varies in a direct ratio of the motion (de la course) and of the surface of the sliding parts (tiroirs), and in the inverse ratio of the motion (de la course) and of the surface of the piston; the other relative to the friction on the bent axle, where we know that this part of the total resistance augments with the diameter of the axle at the crank and at the collar of the axle, and diminishes on the contrary, when the motion of the piston augments."

[As we are apprehensive whether we so clearly understand the principle and spirit of the author in this paragraph, we subjoin the original.]

"Cette formule contient deux termes, l'un relatif au frottement des tiroirs, où l'on reconnaît que la résistance qui en résulte contre la progression de la machine varie en raison directe de la course et de la surface des tiroirs, et en raison inverse de la course et de la surface du piston; l'autre, relatif aux frottements sur l'essieu coudé, où l'on reconnaît que cette partie de la résistance totale augmente avec le diamètre de l'essieu à la manivelle et à la fusée d'essieu, et diminue au contraire, lorsque la course du piston augmente."

“ A modification happens in the formula when there are two or three pair of coupled wheels.

“ The results of this calculation are afterwards found to be verified by the practical investigation of this same additional resistance, or by a series of experiments undertaken for this purpose, and by means of a very simple calculation.

“ Account is taken in this calculation of the resistance of the atmosphere according to direct experiments of the author on great surfaces, which give, as one may expect, a result more considerable than has been generally admitted from experiments made on surfaces of little extent. In fact we know that different surfaces traversing the air with the same velocity do not experience resistances proportional to their extent, but resistances which increase more rapidly than the extent of surface; so that the resistance of the air for a unity of surface is more considerable for great than for little objects. However, this research will be an object to be presented to the Academy hereafter. (See Note C.)

“ Account is also taken in the calculation, of the pressure on the opposite face of the piston by reason of the contraction of the passage through which the vapour makes its exit into the atmosphere. The determination of this pressure results from direct experiments equally made by the author with special apparatus fixed to the engines, and of which he proposes to render an account to the Academy. (See Note D.)

“ The result, as well of calculation as of experiment, on the additional resistance of engines, is, that this resistance is at a medium about  $\frac{1}{4}$  lb. per ton of load for engines with four wheels uncoupled, and 1 lb. per ton for engines having four wheels coupled.

“ The organic resistance of machines, or that which results from the invariable friction of the machinery, remains afterwards to be determined.

“ Theory conducts, in this respect, to a formula in which we observe the influence of the proportions of the machine on its organic resistance. We there see that this resistance augments with the length of the stroke of the piston, the diameter of the cylinder, and thickness of the piston, and diminishes, on the contrary, by the augmentation of the diameter of the wheel.

“ The same organic resistance is afterwards determined by practice and direct experiment, which confirm the preceding considerations. We find that the organic resistance experiences the variations indicated by theory, but that its

mean value, for the engines most in use amounts to perhaps 40lbs.

“These different determinations give the means to estimate *a priori* the passive resistance of a well-made locomotive whose weight is known. We see, in fact, that to the number 40, which represents in lbs. the resistance due to the friction of the machinery, it will be sufficient to add its resistance as a carriage, which will be 8lbs. per ton, and its additional resistance, which will be 1lb. or  $\frac{1}{2}$ lb. per ton, according as the wheels shall or shall not be coupled.

“This manner of calculating the passive resistance is useful as often as we would calculate the effects we may expect, without making a special experiment. But it is especially necessary, previous to constructing an engine, when one wishes to determine the proportions it may be convenient to give it to obtain the effects desired. In this case we may make the calculation without employing the passive presumed resistance of the engine; and as we have always decided beforehand the weight we would give it, we see that it is easy to deduce from it the passive resistance it will have if it is properly constructed.” (See Note E.)

#### NOTES.

(A.) We shall be glad to see the new experiments on this subject we understand M. Pambour has recently made; and we hope he will be more explicit in illustrating his theory by them than he is in his treatise.

M. Pambour has here taken account of the resistance of the atmosphere. We have long insisted on the necessity of this, and in our third Number have given a table of the effects of it. But to preach to our English engineers on the subject of the influence of the wind, is almost like preaching to the wind itself. Now, however that it is taken notice of in France, it will probably be attended to in England.

Some two years ago the Editor of this Journal published his views of the cause of locomotives burning out so rapidly, and suggested a method by which it might be avoided. It fell like a dead letter, unnoticed in England; but in America, (see our No. 6, p. 233) the idea was taken up, followed out, and an engine, made on the principle, worked for nine months, at the end of which time the tubes were as perfect as when new. This neglect by Englishmen of Englishmen's inventions or improvements, has not been the fate of the Editor of the Railway Magazine only. We remember to have heard of a very curious instance in another individual.

Colonel — made a considerable improvement in the

telegraph and presented his invention to the Admiralty. An offensive letter, amounting almost to insult, by telling him that they were so pestered with things of this sort they could not attend to his, was the reply he received from the secretary. Stung at such treatment, the Colonel published an account of his invention in the *Morning Chronicle*. The French seeing this account in an English paper thought it must be a good thing and tried it. It answered admirably, and soon spread over France. A British Admiral (Sir Home Popham we believe) saw it in operation at one of the French sea-ports, boldly sailed in, sketched its *modus operandi* and hastened to the Admiralty with this wonderful "French invention," which he had daringly copied in the midst of a shower of shot. So dangerously purchased, it was, of course, highly prized and instantly adopted. This would all have passed off very well, but, unluckily, the naughty Colonel soon afterwards published his correspondence with the Admiralty, and appended to it his letter in the *Chronicle*, which reduced the poor secretary from his high pinnacle of exulting patronage to be a Croker for the risk to which he had exposed his Majesty's ship, and the lives of brave officers and men, to take that from a foreigner which his stupid illiberal conduct had insultingly rejected from a gallant native.

(B.) This is a very ingenious division, but we are not quite certain it is theoretically accurate.

(C.) We shall be very glad to see these experiments. Our table, p. 95 of Vol. I, was calculated for a barometric pressure of 30 inches, and a temperature of 32° Fahr., and of course for such a sized body as the air could easily follow up at the posterior side. It also appears, from our observations at pp. 90 and 91, that at the temperature of 52° Fahr., our mean temperature, the pressure will be increased in the ratio of about 480 to 500, or that of 24 to 25. We mention this because M. Pambour says his resistance is greater than that usually admitted.

(D.) If these experiments are conclusively made, they will be most useful, not only as regards the theory of the locomotive, but philosophically. We therefore look forward with great interest to their publication.

(E.) Our readers we are sure will as anxiously expect the publication of M. Pambour's labours as we do. His character as a good experimentalist is amply established by his late treatise; and though he has here and there, it appears to us, run a little wild, and has enveloped his illustrations a little too much in mathematical symbols for the general

reader, his work has nevertheless the merit of being one of the most useful, as it certainly is one of the most complete works we have on the subject. We have again, therefore, to repeat our hope that he will not lessen the utility of his labours by giving us theory and experiments without showing us the degree of their concord and discord, which he has too much done in his work alluded to, and thereby very much contracted the range of its utility.

*On the Practicability and Advantage of employing Steam of great density, expansively, in Locomotive Engines.*  
By W. G. A., Esq.

(Continued from Page 167.)

WE now come to the consideration of the reduction which would be effected in the consumption of fuel, and in the weight of apparatus, and generally speaking, the advantage which would accrue from reducing the expenditure of steam to one-third, but at the same time increasing its pressure to the extent proposed.

The quantity of heat actually consumed in the conversion of a given quantity of water into steam, is always the same, no matter what the density of the steam may be; for the differences in the quantities of latent and sensible heat, in steam of different densities, always counterbalance each other, and thus render the sum of the two in all cases equal.\* The quantity of fuel therefore requisite to vapourize a given quantity of water under different pressures, will depend simply upon the greater or less difficulty of imparting the heat to the water, and preventing its fruitless escape by radiation or otherwise.

In the first place let us inquire, how the mere increase of pressure in a common locomotive boiler would affect the efficacy of the fuel, supposing no change to be requisite in the boiler, and the fire to be maintained of the usual size and intensity.

The capacity of the water in a boiler to imbibe the heat of the furnace, depends simply upon the temperature of the water; that is to say, the nearer the temperature of the water approaches to an equality with that of the furnace, with the less avidity, in nearly the same proportion, will the water imbibe the heat to which it is exposed. Now the

\* See Lardner on Heat, p. 164.

temperature of water boiling under a pressure of 302lbs. per inch is 120° higher than that of water boiling under 65lbs. per inch; but it must be obvious that with a furnace of the excessive intensity usual in locomotive engines, the addition of 120° to the temperature of the water could produce no sensible approximation to the heat of the furnace, and therefore neither would such increase of temperature appreciably affect the ability of the water to absorb the heat to which it was subjected. Since then the *capacity* of the water to imbibe the heat, would not be sensibly affected, the only question, as far as regards imparting the heat to the water, is, whether the increase of pressure would abstract or facilitate the *passage* of the heat from the furnace to the water.

In locomotive boilers, owing to the extreme rapidity with which the steam is formed at the inner surface of the metal through which the heat is transmitted to the water, the water is in a great measure displaced from its contact with the metal, a large portion of the surface of the metal being at each instant of time occupied by the steam which is there continually forming. In consequence of the very imperfect contact of the water with the heating surface, which is thus occasioned, not only is the transmission of the heat greatly interrupted, and the efficiency of the fuel thereby considerably impaired, but what is worse, the heat accumulates in the metal, causes it to exfoliate, and thus rapidly destroys the boiler.

Now, if an equally rapid vaporization were effected under a pressure of 302 instead of 65lbs. per inch, then, since the steam formed at the heating surface would be of four times the density, it would only occupy one-fourth the volume, and consequently its presence at the heating surface would only displace the water to one-fourth the extent. In fact, the contact of the water with the metal would in such case, be equal to what it would have been, if the steam, under the 65lbs. pressure, had been propagated only one-fourth as fast. With such a superior contact of the water with the heating surface, it is plain that the transmission of the heat to the water would be *facilitated*, the quantity imparted to it increased, and in all probability the accumulation of heat in the metal, and the consequent rapid wear of the boiler, wholly prevented.

The next question is, how would the increase of pressure affect the proportion of heat which would be lost by the radiation of the boiler?

The rapidity with which heat is radiated from a boiler is proportionate to the disparity between the respective tem-



peratures of the radiating surface, and that of the atmosphere in contact with it. Now, assuming the temperature of the atmosphere to be  $60^{\circ}$ , and the external or radiating surface of the boiler to be equal to that of the water within, (which is the utmost it could be,) the difference between the respective temperatures of the atmosphere and radiating surface would be augmented by the proposed increase of pressure in the proportion of 3 to 2, in which ratio, therefore, the quantity of heat radiated in a given time would also be rendered greater. But in locomotive boilers the heat is imparted to the water with such extreme rapidity, that the quantity lost by radiation in a given time, forms an exceedingly small part of that which is in the same time communicated to the water, so small, in fact, that such an increase as I have just mentioned in its relative amount, would be of very trifling importance.

There is but one other source of waste which attends the propagation of steam in locomotive boilers, which may be thus shortly explained. Owing to the excessive violence of the ebullition, the steam in the boiler becomes impregnated with spray, or particles of unvaporized water, which being carried off with the steam through the cylinders of the engine, occasion a very considerable waste both of heat and water. Now the ebullition attending an equally rapid vaporization under a pressure of 302lbs. per inch, would be only one-fourth as violent as under the usual pressure of 65lbs. per inch, because the volume of the steam evolved from the water, would be in that proportion less in the one case than in the other; and there can be no doubt that such a suppression of the ebullition would entirely prevent the production of spray, and thus wholly remove the origin of the evil.

Hence, then, it appears that the mere increase of pressure, independently of any change it might render requisite in the boiler, would rather increase than otherwise, the present efficacy of the fuel in locomotive engines. This conclusion I believe to be opposed to the common opinion, but I conceive that the difference between increasing the pressure where the water is vaporized with a moderate fire, and with a fire of the excessive intensity of a locomotive furnace, is not generally regarded. With a moderate fire, it will be observed, the transmission of the heat to the water, is not intercepted by the insufficient contact of the water with the evaporating surface, neither is the commotion in the boiler so violent as to occasion the escape with the steam of unva-

porized water in the shape of spray, and, therefore, under such circumstances, the increase of pressure would not possess the advantage, either of facilitating the transmission of the heat, or of removing the source of waste just alluded to. Besides, the less the intensity of the fire, the more would the additional temperature, which the water would acquire under the increased pressure, tend to equalize the temperature of the water with that of the fire, and, therefore, in the larger proportion would such additional temperature diminish the quantity of heat imparted to the water. And, moreover, the longer the time occupied in the communication of a given quantity of heat to the water, the more serious would be the effect of the increased rapidity of radiation, occasioned by the higher temperature of the water. It is only therefore where the water is vaporized with extreme rapidity, as in locomotive engines, that the efficiency of the fuel would not be impaired by increasing the pressure.

Whether or not the relative efficacy of the fuel would be materially affected, by the modification of the boiler, requisite to suit it to the propagation of the reduced quantity of more powerful steam, we shall presently be better able to judge.

The limits of this letter will not permit me to enter into any detailed calculation of the reduction which would be effected in the weight of the boiler, after adapting its size to the propagation of one-third of the quantity of steam, and its strength to the greater pressure it would have to sustain. I shall therefore confine myself merely to a few general observations on the subject.

In the first place, the whole evaporating apparatus might be reduced to one-third the size, with the exception of the steam chamber or space in the boiler allotted to the steam, which might be reduced to one-twelfth, because that would be the relative space which one-third the quantity of steam of four-fold density would occupy.\* The entire apparatus would therefore be reduced in a somewhat larger proportion than the consumption of steam. With respect to its strength, it would by no means be requisite to increase the thickness

\* Even supposing that the suppression of the ebullition to one-fourth its usual violence, would not wholly prevent, but only proportionately diminish the production of spray in the boiler, still the steam-chamber might be reduced to the extent here mentioned, and not only be adapted to contain the same relative quantity of steam, but also be equally suited to the diminished violence of the ebullition, for the purpose of allowing of the partial descent from the steam, of the watery particles with which it would be mingled.

of the boiler (speaking of a boiler of the construction usual in railway locomotive engines) in proportion to the greater pressure of the steam, because, by the mere reduction of its size, and without any increase in the thickness of the metal, it would be enabled to bear a great additional intensity of pressure. Notwithstanding this, however, a large increase of thickness would, no doubt, be requisite to give the boiler the usual proportion of strength above so greatly an increased pressure as that proposed. As to the tubular flues which traverse the boiler, their strength would be sufficient, without any increase of their usual thickness. Taking these and all other matters into account, it may be found that a saving of about *one-third* would be effected in the entire weight of the evaporating apparatus.

To return for a moment to the consideration of the efficacy of the fuel, it is to be observed that the radiating surface would not be reduced in the same ratio as the capacity of the boiler, and notwithstanding that the boiler would be diminished in a larger proportion than the consumption of steam, still the radiating surface would not be reduced quite to the same extent as the quantity of water to be vaporized. The relative loss, therefore, by radiation would be in some measure increased by the reduced size of the boiler. The transmission also of the heat to the water would probably be in some degree impeded by the greater thickness of the casing of the fire-box (the flues, I have already observed, would require no increase of thickness). However, I do not apprehend that the requisite modification of the boiler would materially affect the relative efficacy of the fuel. On the whole, therefore, we may conclude that the saving of fuel would be fully commensurate with the reduced consumption of steam.

As to the risk of explosion, I can see no reason in the world why such a modified boiler, possessing the usual proportion of strength above the pressure it was intended to bear, should be more liable to explode than a common boiler in which steam of the usual pressure was propagated. On the contrary, from its smaller size, the risk of unequal wear, and of defective places in the metal and fastenings, would be diminished, which, of course, would tend to lessen the liability to explosion. And with regard to the *effects* of an explosion, when it should occur, taking into consideration that the boiler would only contain one-third of the quantity of steam, and what is of more importance, only one-third of the quantity of water (for nearly all the mischief is done on

such occasions by the scalding water), I cannot think that the consequences would be more fatal or serious than they now generally are, if, indeed, they would be so much so.

In adapting tubular boilers, such as are used in steam-carriages on common roads, to the propagation of a reduced quantity of more powerful steam, a smaller increase of thickness would render them sufficiently, if not equally secure.

Thus, then, if the foregoing conclusions be correct, the effect of so increasing the density of the steam and employing it expansively to the extent suggested, would be to reduce the consumption of fuel and water to *one-third*, and considerably to lessen the weight, and I may add, the cost, of the evaporating apparatus; besides which, by propagating the steam under the increased pressure, the exfoliation and consequent rapid wear of the boiler, would in all probability be prevented; all which advantages would be obtained without increasing the risk of explosion, or aggravating its consequences whenever it should occur.

Not having the advantage of being professionally an engineer, I offer these observations with great diffidence, and feel that I may in many instances have fallen into errors, but if I should succeed in drawing the attention of more competent persons to the subject, my object will be attained.

In conclusion I may observe, that the economy of fuel which I conceive would be effected by the adoption of the principles I have recommended, would be of even greater importance in steam navigation, than in steam locomotion, for at present the enormous expenditure of fuel is a complete bar to the profitable employment of steam-vessels on long voyages.

W. G. A.

### *Duplicate Tunnels.* By Mr. H. ROWLEY.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—I observe in your last month's Number a letter from Mr. Booth, suggesting duplicate tunnels for single lines of railway in reversed directions, so as to *descend only*. I beg to notice to you that whatever merit may be due to Mr. Booth for his invention, he has been preceded some years by Mr. W. D. Holmes, who adopted that mode in his projects for the "Midland Grand Junction Railway," and the "Metropolitan Junction Railways," with this further advantage,

that instead of being an inclination only to assist the engine, he gives that inclination in most of the tunnels through London which will be sufficient to ensure the descent of the trains by their own gravity only—thereby dispensing with engines in long tunnels altogether—while he at the same time reduces very much the cost by rendering a less tunnel necessary. Your inserting this in your next Number will much oblige—your obedient servant,

1, *Warnford Court*,  
*Throgmorton Street, March, 1837.*

H. ROWLEY.

*Conspectus of the Traffic on the Liverpool and Manchester Railway for Six Years.*

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—The following Tables have been compiled with considerable care from the Reports of the Liverpool and Manchester Railway, recently published in a collected form.\* They exhibit the traffic and progress of the railway, for the six years from 1st Jan., 1831, to 31st Dec., 1836, and cannot but be useful to all those interested in similar undertakings. Facts are the strongest of arguments; and a careful examination of these Tables will, I doubt not, convince the most sceptical that, in spite of all the disadvantages attending a first undertaking of its kind, the Liverpool and Manchester Railway has been, and is morally certain to continue, a most profitable investment for capital, as well as a vast public convenience. The same must be the result in all other cases, where the line connects places or districts of great intercourse, and especially where those improvements which the Liverpool and Manchester Company have had to attain by slow and costly experience, are originally adopted and carried into effect.

The Tables, it is believed, will be readily understood without much explanation. As the reports of the Directors are half-yearly, the traffic and receipts are, in the first place, exhibited for the *corresponding six months* in the several years (as far as practicable) and afterwards for each *entire* year. It is to be regretted that the Directors have discontinued the publication of some particulars in their later

\* By R. H. Moore, Paternoster-row, London, 1837.

Reports, which would have made the comparison more interesting and complete; but the statement of receipts, disbursements, and profits, is a sufficient indication of the general progress of the concern, and of its increasing prosperity to the present time.

Some surprise, perhaps, will be felt in observing the magnitude of the Company's disbursements compared with the gross receipts, but there are good reasons why, in this respect, a more favourable result may be expected in the case of the great lines now in progress. It is almost impossible to enumerate the items by which the expenditure, in a first great experiment of this kind, is unavoidably swelled; but any one who will examine the Reports of the Liverpool and Manchester Company, and notice the difficulties with which they had to contend, and the necessity they were under of superseding one improvement by another, will be convinced that undertakings, commenced with the benefit of their experience, start at an immense advantage. It is to be recollected also, that, besides a very heavy charge for interest on loans (upwards of 13,000*l.* per annum), the disbursements have been greatly increased by providing a large part of the *carrying establishment* out of the annual income, and by the greater solidity and strength it was found necessary to give to the locomotive engines. A heavy charge also has been made on the income for the cost of *relaying* the road with stronger and heavier rails than those originally laid down, at a time too when iron was at its highest price. Combining these facts with the improved levels and modes of construction now applied to railways, we may fairly assume that the ratio of expenses for maintenance of the way and locomotive power will be far lower upon the great lines now making, than has hitherto been the case on the Liverpool and Manchester line. Mr. George Stephenson, indeed, has given it as his decided opinion that, in the case of a railway with very favourable gradients, *one-third* of the gross revenue will be quite sufficient to pay all contingent expenses.\* If we suppose, however, that even *one-half* of the gross receipts are thus required, it will be found that such an impulse is given to personal locomotion and all kinds of traffic in the districts adjoining to a great line of railway, by the speed, regularity,

\* Report to the Glasgow, Paisley, and Greenock Railway Company, 16th October, 1836.

security, and economy of transit which it ensures, as will increase the revenue in a far higher ratio, and thus afford an ample remuneration for the capital invested.

With reference to that most important item of expense—the locomotive power—nothing can be more satisfactory than the experience of the Liverpool and Manchester Directors, when they state, “that great improvements have already been effected in its construction, and that these improvements, they have no doubt, will go on till the efficient parts of the machine shall be rendered still more perfect, and till its present defects shall be in a great measure, if not altogether, remedied. Future undertakings will reap the benefit of the experience which has thus been purchased (unavoidably at a high price) by the Company of the Liverpool and Manchester Railway.”\*

I am, Sir, your most obedient servant,  
R. R.

\* Reports of the Liverpool and Manchester Railway, p. 48.

TABLE I.

Dates.		Merchandise conveyed on the line. Tons.	Coals conveyed on the line. Tons.	Passengers booked.	No. of trips of 30 miles by locomotives.
In the half year ending June 30,					
	1831	42,692	2,889	188,726	not given
	1832	72,601	29,456	174,122	5,118
	1833	96,457	41,375	171,421	5,506
	*1834	104,356	46,039	200,676	5,816
In the half year end- ing December 31,					
	1831	65,488	8,396	256,321	5,392
	1832	86,842	39,940	182,823	5,253
	1833	98,247	40,134	215,071	5,840
In the year ending December 31,					
	1831	108,180	11,285	445,047	5,392 $\frac{1}{2}$ yr.
	1832	159,443	69,396	356,945	10,371
	1833	194,704	81,509	386,492	11,346

\* From this period the directors discontinued the publication of the quantities of merchandise and coal and number of passengers, but the receipts, under these different heads, for the three following years are shown in Table II.

TABLE, No. II.

DATES.	GROSS RECEIPTS, from			DISBURSEMENTS.		Total Gross Receipts.	Total Disbursements.	Total Net Profits.	PROFIT.		Dividend per £100 Share.
	Passengers.	Merchandise.	Coal.	In Coach-On Merchandise part- and Coal.					On Passengers.	On Merchandise and Coal.	
				£.	£.						
* In the Half-year ending 30th June, 1831	43,600	21,875	218	19,100	16,279	65,693	35,379	30,314	24,500	5,814	4 10 0
" " " " " "	40,045	32,478	2,184	21,957	24,701	74,707	46,658	28,049	18,088	9,961	4 0 0
" " " " " "	44,131	39,301	2,639	24,746	28,154	86,071	52,900	33,171	19,385	13,786	4 4 0
" " " " " "	50,771	41,088	2,926	28,682	31,411	94,785	60,093	34,692	22,089	12,603	4 10 0
" " " " " "	52,437	43,631	3,407	not published.		99,475	61,814	37,661	not published.		4 10 0
" " " " " "	57,914	47,441	4,000	ditto.		109,355	69,953	39,402	ditto.		5 0 0
In the Half-year ending 31st Dec. 1831	58,348	30,765	696	25,930	23,096	89,809	49,026	40,783	32,418	8,365	4 10 0
" " " " " "	43,120	34,978	2,804	23,745	24,533	80,902	48,278	32,624	19,375	13,249	4 4 0
" " " " " "	54,685	39,958	2,591	27,345	29,005	97,234	56,350	40,884	27,340	13,544	4 10 0
" " " " " "	60,292	41,198	3,409	not published.		104,899	64,553	40,346	not published.		4 10 0
" " " " " "	67,898	46,376	3,682	ditto.		117,956	71,996	45,960	ditto.		5 0 0
" " " " " "	75,987	45,743	3,550	ditto.		125,280	79,629	45,651	ditto.		5 0 0
In the Year ending 31st Dec. 1831	101,948	52,640	914	45,030	39,375	155,502	84,405	71,097	56,918	14,179	9 0 0
" " " " " "	83,165	67,456	4,988	45,702	49,234	155,609	94,936	60,673	37,463	23,210	8 4 0
" " " " " "	98,816	79,259	5,230	52,091	57,159	183,305	109,250	74,055	46,725	27,330	8 14 0
" " " " " "	111,063	82,286	6,335	not published.		199,684	124,646	75,038	not published.		9 0 0
" " " " " "	120,335	90,007	7,089	ditto.		217,431	133,810	83,621	ditto.		9 10 0
" " " " " "	133,901	93,184	7,550	ditto.		234,635	149,582	85,053	ditto.		10 0 0

\* A previous dividend of 2*l.* per Share was declared on the 23rd of March, 1831, out of the Net Profits of the Railway, from the 16th of September, 1830, (date of its opening), to 31st of December, 1830.



*Cheltenham, Oxford, and London Railway.*

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—I think you have performed a duty to the public, and for which they are under deep obligations, in the exposure you have made in your Numbers for January and February, of the misconduct of the Directors of the above-mentioned Railway Company, who have imposed upon the shareholders the most barefaced \* \* \* \*. (a) The pamphlet to which you allude in your February Magazine, called "A Voice from Cheltenham," first opened the eyes of the public to the deceptions practised by the Tring Directors, and at this moment remains unanswered, notwithstanding the statements therein made conveying charges which, if false, ought to have been rebutted in a court of justice. The truth, however, is that those statements are *unanswerable*.

My object in now addressing you is, to call your attention to a paragraph contained in the recent Report of the Directors of the London and Birmingham Company, dated the 3d Feb. inst., to the following effect:—

"The House of Lords having declared in the last session of Parliament that the Cheltenham and Oxford and London and Birmingham Railway Union Company is *not* a 'competing line,' the Directors, in the conviction that the proposed communication will be of great importance to the Company, and in compliance with the wishes of the proprietors, have decided to give it all the support they can."

Now, in point of fact, the House of Lords declared that it *was* a "competing line," and the only question was as to "its main objects." And Mr. Pearson Thompson, the Chairman of the Tring Company, declared, on oath, that "HE WAS SURE they would be considered as competing lines." I put it, therefore, to the good sense of every honest man, whether it be fair, or even decent, to foist such trickery as this upon the public, and in the shape of a report. If the Directors of the London and Birmingham Company will persist in such a course, all confidence in their management must cease. Their affairs are bad enough already, without throwing away more money in endeavouring

(a) We are sorry these observations are needed. What confidence can the public or Parliament place in men who have so forgotten what is due to their own characters?—ED.

to bolster up the Tring scheme. The present estimated cost of their main line is 4,446,594*l.*, whereas the Parliamentary estimate was only 2,500,000*l.*, thus making an excess of nearly TWO MILLIONS, the *interest* of which only, at 5 per cent., will be 100,000*l. per annum*, to be paid out OF THE PROFITS. I will make only two extracts from their last Report, as specimens of good management :—

	Present Estimated Cost.	Parlia- mentary Estimate.	Excess.
Stations and Carrying Department,	£408,236	£80,000	£328,236
General Charges . . . . .	321,984	99,191	222,791
	730,220	179,191	551,027

Thus, upon two items of 179,191*l.*, presenting an excess of 551,027*l. beyond the original estimate.*

Instead, therefore, of expending any more money upon the Tring bubble, it seems to me that it behoves our Directors to look “at home,” and be a little more chary of our pecuniary resources. I am, Sir, yours, &c.,

*Birmingham, Feb. 9, 1837.*

ANTI-HUMBUG.

## REPORTS.

### BIRMINGHAM, BRISTOL, AND THAMES JUNCTION RAILWAY COMPANY.

#### SECOND HALF-YEARLY GENERAL MEETING OF PROPRIETORS.

THE General Meeting of the “Birmingham, Bristol, and Thames Junction Railway Company,” was held on Wednesday, the 8th of March, 1837, Henry Luard, Esq., in the Chair.

#### *Report.*

The Directors of this Company have the satisfaction of stating that, although in the six months which have elapsed since the last General Meeting, some difficulties have opposed themselves to the commencement of the Company's original undertaking, they are now enabled to announce that every impediment to it is at last removed, that the works are begun, and that before the arrival of the spring a visible and important progress will have been made. The Directors had hoped that, in pursuance of the authority given to them at a General Meeting of the Shareholders, they should be able on this occasion to report the progress of the necessary Bill for the extension of the line to Knightsbridge-green, but

although a sufficient number of shares has been already subscribed for to carry that measure through the House of Commons, yet the unexpected impediments opposed by two leading proprietors of land on the line have been such as to allow no chance for the present session of effecting the intended extension. It is hoped that, by certain alterations, concessions, and compensations, these impediments will before next year be effectually removed, and the intervening time and opportunity will be diligently employed for this purpose.

As the other works of the Company could not at the earliest have been completed in less than a year and a half from this date, a delay until February next will be productive of no eventual loss to the Company, and if they then succeed in the important object of bringing the passengers who arrive from the north and west of England to the very threshold of London, instead of leaving them to find their way into the metropolis from the comparatively distant points of Kensington, or Paddington, or Somers-town, the additional traffic, it is confidently anticipated, will be such as to produce a more than proportionate increase in the revenues of the Company, and amply redeem the present delay.

The past delay, of which the shareholders will be naturally anxious to have some account, has been principally caused by circumstances arising out of the alteration in the line of the Great Western Railway, and by difficulties connected with the purchase of the Kensington Canal.

The Great Western Railway, instead of converging, as was originally intended, into the London and Birmingham line, has fixed its terminus at a spot which lies westward of the Edgware-road; and for the purpose of reaching that spot in a manner independent of this Company, the Directors of the Great Western Railway Company endeavoured to get possession of certain land at Wormholt Scrubbs, to which this Company claimed a prior and superior title. It was an object with both parties to obtain the land; especially to this Company, who, without it, could make no advantageous commencement of the railway. But it was also an object with both Companies to avoid litigation, and thus an arrangement has at length been concluded, which, it is hoped, will be mutually safe and advantageous: under this arrangement, the title to the soil has been duly conveyed to this Company, who are now in possession; a right of way across the land has been conceded to the Great Western Railway Company: and the works of this undertaking are now proceeding with regularity and despatch.

The negotiation respecting the Great Western Railway having thus been satisfactorily concluded, the chief remaining embarrassment was that which had arisen out of the circumstances connected with the Kensington Canal. The Directors of this Company, early in the autumn, were preparing to commence the operations, announced in the last Report, for putting the canal into an efficient

state, when a difficulty, not originally foreseen, presented itself on the part of certain creditors of that canal, who were incumbrances upon its land. For some little time an apprehension was even entertained, that the purchase of the canal must be altogether abandoned. At length, however, the outstanding creditors have entered into a negotiation with the Canal Company, and the Directors hope that they will speedily be in a condition to congratulate the shareholders on the removal of this embarrassment. The canal will then be immediately brought into a more efficient condition; and though its tolls are chiefly to arise from its connexion with the future railway, yet, even within the early period of the approaching summer, it is expected to become productive of a valuable revenue.

The long correspondences, the repeated personal interviews, the renewed discussions, and the anxious deliberations, which were rendered indispensable by the obstacles already enumerated, and, in addition to these duties, the new functions devolved upon the Directors by the proposed extension of the line, have occupied their unremitting attention, once, twice, and often thrice a-week, during the whole of the period which has elapsed since the last General Meeting. But this employment, though certainly much more engrossing than they had reason to anticipate when they accepted the honour of the Direction, has not been without its gratifications; for it has given them a closer and a clearer view than perhaps they could otherwise have attained of the great advantages which this undertaking is likely to pour in upon its proprietors.

Without entering into details, or setting forth the various collateral considerations, which illustrate the general prospects of the plan, and justify the best hopes of its proprietors, it may be well to remind the Meeting that, in addition to the passenger traffic which former data entitled this Company to expect from the Great Western and from the London and Birmingham Railways, and for which complete and satisfactory arrangements have been made with the Directors of both those undertakings, other sources of revenue are already developing themselves. The canals which connect themselves with the railway of this Company are opening new and exclusive prospects of advantage to it. In the line of the Grand Junction Canal, one of the great feeders of this railway, alterations of the utmost importance are about to take place, particularly a straight and short navigation between that canal at Cashio Bridge, near Watford, and the Paddington Canal at Apperton, which will save twelve miles upon the passage of all goods conveyed by the Grand Junction Company; effect a proportionate reduction in their tolls; increase by consequence the amount of their traffic; and, by discontinuing the present approach to the Thames at Brentford, oblige the cargoes destined for that river to enter it by the more commodious access which the railway of this Company and the Kensington canal will afford.

Again, a railway is projected from Southwark-bridge to join the Southampton Railway, to cross the Thames near Battersea-bridge, and to enter this Company's railway at the Hammersmith-road, thus completing the communication between the railways on the north and those on the south of the Thames. For this object a Bill has been introduced into Parliament, and its promoters have made arrangements with the Directors of this Company for the junction of the two lines and the interchange of traffic.

Under all these circumstances, the main difficulties of arrangement being removed, and the works both of the Birmingham and Great Western Railways being now in a state of rapid advancement, the Directors, notwithstanding the unsettled state of the money market and the depression of other railways less solidly grounded, have no hesitation in expressing their own feelings of alacrity and confidence, and in inviting the Proprietors to provide the means of vigorously prosecuting their works by an early call.

The statement of the accounts of the Company to the 31st of December last, which has been prepared as directed by the Act, will show that the receipts were then 13,349*l.* 8*s.* 9*d.* and the disbursements 11,114*l.* 7*s.* 5*d.*, leaving in the hands of the bankers on that day a balance of 2,235*l.* 1*s.* 4*d.*

*Statement.*

By first call (deposit) of 1 <i>l.</i> per share . . .	6,072	0	0		
Interest on exchequer bills . . . . .	5	1	3		
				£6,077	1 3
Second call of 2 <i>l.</i> per share . . . . .				7,272	7 6
				£13,349	8 9

	To 16th Aug. 1886.			To 31st Dec. 1890			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.
To legal and Parliamentary expenses . . . . .	1,162	16	0	1,457	9	7	2,620	5	7
Engineering and surveying . . . . .	1,267	17	0	98	14	3	1,366	11	3
Salaries . . . . .	244	0	0	711	0	6	955	0	6
Advertisements . . . . .	369	12	10	203	8	11	573	1	9
Office disbursements, including agency, rent, &c. . . . .	271	12	2	112	19	6	384	11	8
Office furniture . . . . .	171	0	3	.	.	.	171	0	3
Printing and stationery . . . . .	185	7	7	301	8	6	486	16	1
Kensington Canal Company . . . . .	1,300	0	0	100	0	0	1,400	0	0
Provisional Committee . . . . .	.	.	.	500	0	0	500	0	0
Direction . . . . .	.	.	.	300	0	0	300	0	0
Land and compensation . . . . .	.	.	.	3,518	15	0	3,518	15	0
Kensington Canal improvement and works . . . . .	.	.	.	44	19	1	44	19	1
	£4,972	5	10	7,348	15	4	12,321	1	2

Less the undermentioned sums not paid, viz.—			
Legal and Parliamentary expenses . . . . .	£709	11	7
Salaries . . . . .	316	0	6
Direction . . . . .	161	1	8
Rent . . . . .	20	0	0
	<hr/>		
		£1,206	13 9
		<hr/>	
		11,114	7 6
Balance of cash at the London and Westminster Bank . . . . .		2,235	1 4
		<hr/>	
		£13,349	8 9

## BRISTOL AND EXETER RAILWAY.

## HALF-YEARLY GENERAL MEETING OF THE PROPRIETORS.

THE Half-Yearly General Meeting of the Bristol and Exeter Railway Company, was held in the City of Bristol, on Thursday, the 23d of February, 1837, and very numerous attended; Frederick Ricketts, Esq. in the Chair.

*Report.*

The Directors regard with satisfaction the return of the period for submitting an account of their own proceedings, and of the general prospects of the Company, to the great body of its Proprietors.

Since their last General Meeting various and highly desirable improvements have been effected in the line of railway, and considerable progress made towards their actual accomplishment.

Amongst these, it may be stated that two out of the three inclined planes formerly contemplated have been entirely avoided, and that the gradients upon this part of the line have been reduced to moderate inclinations, well calculated for the advantageous use of locomotive power. By this alteration the first high ground south of Bristol, will be passed without any inclination exceeding 15 feet per mile, and the whole of the distance between Bristol and Taunton,—which, being capable of completion at an earlier period than the southern half of the line, has received more immediate attention, and been the first revised—will now consist of only  $4\frac{1}{2}$  miles of one foot in 352; 5 miles of one foot in 440—and about 35 miles of *level*,—an amendment which must be regarded as most essential, affecting so materially as it does, the future economy of the working of the line; on the remainder of which, when permanently set out, there is also reason to anticipate great improvements.

The radius also of the only unfavourable curve occurring in the course of the main line, has been so much extended as to present no impediment to the safest transit of carriages at full speed; and the Directors have the gratification of stating, that from the favourable nature of the materials throughout which the cutting at the summit

level will be carried, and the unexpensive arrangement for improving the curve, these valuable amendments will be obtained without causing any increase of expense affecting the integrity of the original estimates.

Three shafts are already in course of completion at the tunnel at the White Ball Hill, near Wellington, and exhibit a succession of strata in every respect verifying the anticipations formed of the security and economy of its construction.

Two contracts, of nearly eleven miles in extent, and including the only costly and the most difficult operations that will be required throughout a length of fifty miles, have been let to respectable contractors, on such terms as render certain, even at this early stage of the proceedings, the expense and period of completion of nearly two-thirds of the main line, being the whole distance between Bristol and Taunton; and the actual outlay upon which will not amount to above three-fourths of the average cost per mile of the entire line, as projected and estimated on the formation of the company.

Of these contracts, the works on one have been already commenced; and on the other—along which a valuable and extensive stock of working materials has been deposited by the contractor for several weeks—have been delayed only in consequence of such impediments in the purchase of land as have been incidentally occasioned by the late prevailing epidemic.

It will be considered highly honourable to the engineer, and to those engaged with him, for the Directors to be enabled to assure the proprietors, that although the unremitting investigations of nearly eight months have disclosed many unexpected advantages, a portion of the results of which has been already mentioned, yet that the closest subsequent examination of a line of seventy-five miles in length, surveyed with unexampled rapidity, has not only removed all apprehension of the necessity of any further application to Parliament, but has even strengthened the conviction that the track so promptly adopted, is, in reality, the most favourable that could have been selected under any circumstances.

But the distinguishing peculiarity of the Bristol and Exeter Railway, which cannot be too perfectly understood, or too constantly borne in mind by its shareholders, is that *exclusiveness of position* adverted to in the former Report; and which, taking into account its extent, and the magnitude of the interests protected by it, is at present, and will probably continue to be, without a parallel. Traversing the only accessible valley between two seas, and closely bordered by ranges of impassable hills extending northward and southward to the water's edge of the Bristol and English Channels, this line may safely be asserted to afford the *only* practicable communication by railway betwixt on the one hand, the important counties of Somerset, Devon, and Cornwall, comprising a population of upwards of a million and a quarter; and on

the other hand, the whole population of the remainder of Great Britain.\*

At the present period, some anxiety has naturally been created by the recently announced intention of the London and Birmingham Railway Company, to increase considerably their original capital. In alluding to this subject, the Directors earnestly disclaim the shadow of an intention to impugn either the discretion or the ability of those to whom the accomplishment of that great national work has been confided, and still less to minister to an apprehension that even the required extension of its capital will be otherwise than amply remunerated; but to those unacquainted with the particular sources of the increased expenditure which has occurred upon the London and Birmingham Railway, and the great additions and extensions that have been made to that railway as originally projected, and which do not of course apply to the case of the Bristol and Exeter line, it may be desirable briefly to point out the more prominent features of the distinction to be made betwixt the two undertakings. Neither the costly extension of the line of the former beyond the original terminus into a populous part of London—nor the great sacrifices that were made for the purpose “of obtaining possession of land at an earlier period, than by the provisions of the Act they could legally enforce”—nor the difficulty of procuring stone and materials for the blocks and permanent way—nor the difficulty and consequent expenses attending the formation of tunnels and excavations through that worst of materials, the London clay—nor the large expenses incurred in Parliamentary proceedings, whether in the application for the original Act, or for the subsequent powers of deviation and amendment, have any parallels in the case of the Bristol and Exeter line; in which, on the contrary, the original project comprehended every thing which it now appears can be required: and the estimates having included the junction with the Great Western, and the entrance into Exeter, no extension of outlay can be anticipated.

In the second place, having secured the commencement of the most important work in the neighbourhood of Bristol, it is not the intention of the Directors, nor is there any necessity, to force the

\* This important fact is no longer to be received as hypothetical, the following being the official and published declaration of the Provisional Committee of a projected line (the South Western), at the close of a persevering, a costly, and an ably-directed effort to effect the continuation of a railway from Basingstoke to Exeter, southward of the Vale of the Taunton Dene. “The original intention, it is stated, was to have passed through the towns of Sherborne, Axminster, and Honiton; but the formidable opposition offered by the features of the country, the numerous tunnels, planes requiring assistant engines, and the general impracticability of the whole, which no justifiable expenditure of money could overcome, have compelled the abandonment of that line:”†—thereby obliging its route to Exeter to be continued along the line of this Company, from a point of junction betwixt Bridgewater and Taunton.

† See Prospectus published by the Committee of Management of the South Western Railway, dated 27th July, 1836.



negotiations for land so as to interfere with a proper and deliberate investigation into its real value.

Thirdly—The excavations on the line itself furnish all those materials required for the permanent way, which have proved so expensive in the other case.

Fourthly—There are no deep cuttings or tunnels through clay; indeed the only tunnel occurring on the whole line is carried through materials which, upon the closer investigation referred to in a former part of this Report, prove to be more favourable than was even anticipated.

And, lastly—When, to the foregoing considerations it is added, that from the burthensome expenses of Parliamentary and law charges occasioned by requisite deviations, or by the support of auxiliary, or by the resistance of interfering lines, the Bristol and Exeter Railway is happily exempted by its geographical position, it will be evident that in almost every point upon which any excess appears to have occurred, the circumstances of the two undertakings are totally dissimilar, and that the experience of the London and Birmingham Railway tends to remove, rather than cause any just apprehension of excess on the Bristol and Exeter line, as proving that the latter is not liable to those difficulties from which increased expenses are to be calculated on.

The Directors present an account of the receipts and disbursements to the 31st of December last, from which it will be seen, that after discharging every liability to that time, a balance, exceeding the full amount of the second instalment, exclusive of the sum of £700, arising from its temporary deposit with the Company's bankers, still remained unappropriated.

Contracts, however, for eleven miles of the line, having been entered into, and the work commenced, and further portions of the line being now ready for tenders, the Directors have made a call of 5*l.* per share, to become payable on the 3d of April.

On the subject of revenue, the Directors have the gratification of stating that, added to their increasing confidence in the ample sufficiency of the productiveness of the undertaking as previously developed, circumstances have recently led them to entertain the fullest conviction that its advantages, as an investment, will be largely augmented by its contiguity to the Nailsea coal-field; and that the result of facts, already ascertained, with respect to the price, quality, and abundance of the coal—to its nearness to the surface, and to the railway—to the unusual facilities and economy of conveyance presented by the line itself—to the proximity of the coal-field to the city and port of Bristol, and to the almost unlimited demand of a vast and populous country to the westward, the supply of fuel to which has hitherto been at once expensive and precarious, has been such as to establish a reasonable and well-founded belief, that from a source of income scarcely adverted to on any former occasion, an actual additional annual dividend of at least 5*l.* per cent. upon the entire proposed capital will be eventually realized.

On the whole, the Directors desire to express their implicit but deliberate persuasion, that, whether considered with reference to the unequalled advantages of the *natural levels*, over which the line passes in the north-eastern half of its extent;—to the unapproachable security of its position, from its entrance into the Vale of Taunton Dean to its south-western terminus, being such as in fact renders it a *peninsular* railway;—to the remarkable economy of its construction;—or to the commercial and social intercourse betwixt the western counties and every other part of the kingdom, of which it cannot fail to become the focus;—the Bristol and Exeter Railway must eventually prove one of the most useful public works, as well as beneficial investments of capital, which the enterprising spirit of the age has yet originated.

FREDERICK RICKETTS, *Chairman*.

*Railway Office, Broad Street,  
23d February, 1837.*

*Statement of Receipts and Expenditure.*

*Dr.*

To capital on 15,000 shares, at 5		£75,000	0	0
Deduct payments retained by landowners in respect of shares held in exchange for land.....	60	0	0	
Arrears due on the 2d instalment	2,862	10	0	
			2,922	10 0
				72,077 10 0
Add interest received on bankers' balances, &c.....	725	14	11	
Registration and transfer fees	20	10	0	
			746	4 11
				<u>£72,823 14 11</u>

*Cr.*

By sundry expenses incurred previous to the Act of Incorporation to the 30th of June, 1836, as laid before the General Meeting on the 2d of July last, and already published.....	£25,847	15	1
Engineering Department includ- ing surveying.....	£5,228	19	9
Advertising, printing, &c., includ- ing the Indexes to Act of Par- liament and Book of Reference	402	1	6
Compensation for damages on land.....	33	16	0
Parliamentary expenses.....	41	5	6

Law charges, conveyancing, &c.	652	2	10	
Country agents' charges.....	47	2	1	
Travelling expenses.....	106	4	0	
Office expenses, direction, salaries, office furniture, and incidental disbursements.....	1,978	5	6	
				8,489 17 2
Balance.....				38,486 2 8
				<u>£72,823 14 11</u>

## YORK AND NORTH MIDLAND RAILWAY COMPANY.

EXTRACT from the Report of the Directors to the Shareholders, at their Half-yearly General Meeting, held on the 27th day of January, 1837; George Hudson, Esq., Chairman.

With regard to the commencement of the railway, the operations will at present be confined to that part of the line between York and Copmanthorpe. The Directors are now in treaty with the different landed proprietors on this portion of the ground, and as soon as the necessary arrangements are concluded, tenders will be received for this section of the work.

As to the deviations, one of them consists in shortening the two branches which are requisite for effecting a junction with the Leeds and Selby Railway. The unequal manner in which tolls for passengers are allowed to be taken by the Leeds and Selby Railway Act was the cause of these branches being laid down so much longer on the original plan: but the Directors of that railway having consented to an equitable adjustment of the tolls, the reason for this extension of the branches ceased. The shortening of this part of the line will save the Company the making of upwards of three miles of railway; and the branches when shortened will be in every respect as convenient for communication with Selby and Hull as those at present authorized.

Another deviation is applied for in consequence of an agreement with a proprietor of an estate upon the line sanctioned by the Act. The landowner alluded to, was at first favourable to the railway passing through his property, but afterwards, for some reasons unknown to your Directors, became much opposed to it. It was unfortunately then too late to alter the line in time to comply with the standing orders of Parliament for last session; and the London deputation, after much negotiation, eventually consented to apply for a deviation of the line. The alteration in this part of the line will render it both shorter and less expensive.

As the necessity of applying again to Parliament was thus imposed upon the Company by the agreements alluded to, the

attention of your Directors was turned to the other portions of the line. The formation of the Southern end of the railway will be considerably the most expensive; and the engineer was directed to examine that part with the greatest attention. The result of this investigation was a strong recommendation by him to carry the railway on the northern, instead of the southern, side of the river Aire. Such an alteration, he reported, would not only render the line equally convenient for communication with the other great railways with which the York and North Midland is proposed to be connected, but would cause a considerable saving to the Company in the construction of the works. Amongst the advantages to be gained by adopting the latter deviation may be named, that a bridge over the river Calder, which would necessarily have been of considerable dimensions, and consequently very costly, will be entirely dispensed with; and the bridge over the Aire, instead of being on the large scale which it must have been if made across the river between Fairburn and Fryston, according to the Parliamentary plan, will be considerably smaller, as the railway will pass the river at a point where it is much narrower, being several miles higher up and before its junction with the Calder. The line also on the northern side interferes with no gentleman's residence, whilst on the southern side it approached the immediate vicinity of a superior mansion and grounds; and should the railway be taken south of the Aire, a considerable sum must necessarily be paid as compensation for the injury the mansion alluded to will sustain. It may also be added that by this deviation to the northern side of the river, lime will be procured at Fairburn, and coal in the adjoining township, as well as on a considerable portion of this part of the new line. With the exception of the extreme end of Methley, there is, it is understood, no coal now worked on the Parliamentary line.

The preceding remarks will, your Directors trust, be sufficient to satisfy the shareholders that there are not only sufficient grounds for applying again to Parliament, but that considerable advantages will accrue to the Company if the suggested alterations can be obtained.

In the event of the proposed deviations being effected, it will not be necessary to have so large a capital as is required by the present Act. The engineer has not yet been able to go so minutely into the calculations as to state precisely the specific sum that can be dispensed with; but it must be obvious to all, from the shortening of the line, the saving in bridges, and other parts of the works, that a considerable reduction, amounting, as your Directors have reason to expect, to at least £50,000 will be effected.

The usual notices and other preliminary measures have been taken for enabling the Company to apply to Parliament in the ensuing session. The expenses of applying to Parliament will be trifling, compared with the expenses of obtaining the original Act, and many charges, which are necessary on a first application, will now be dispensed with.

*A General Statement of Receipts and Payments to the 31st December, 1836.*

**RECEIPTS.**—Money for deposits and call on shares 16,436*l.*; Money for certificates, 36*l.* 4*s.* 4*d.*; Ditto interest, 2*l.* 1*s.* 2*d.*; Ditto transfer fees, 1*l.* 5*s.* Total, 16,475*l.* 10*s.* 6*d.*

**PAYMENTS.**—General expenses, comprising brokerage, salaries, postages, carriage of parcels, travelling, and sundry small incidental expenses, 755*l.* 8*s.* 1*d.*; solicitor's bill for obtaining the Act, including payments to parties in assisting to obtain consents, &c., 2,283*l.* 5*s.* 4*d.*; Parliamentary agent's bill, including counsel fees, also fees to both Houses of Parliament, 1,912*l.* 12*s.*; payments in London to witnesses for their travelling and other expenses, 854*l.* 2*s.* 8*d.*; engineering expenses, 1,794*l.*; surveying ditto, 1,640*l.* 2*s.* 6*d.*; York and Leeds Railway expenses, 391*l.* 6*s.* 3*d.*; advertising, printing, and stationery, 108*l.* 2*s.* 10*d.* total, 9738*l.* 19*s.* 8*d.*; leaving a balance in hand of 6736*l.* 10*s.* 10*d.* 500*l.* per annum were voted for the service of the Directors.

**LONDON AND SOUTHAMPTON RAILWAY COMPANY.**

THE Fifth General Half-yearly Meeting of the Proprietors of the London and Southampton Railway Company, was held on Wednesday, the 15th of February, 1837; John Easthope, Esq., in the chair.

*Receipts.*

On Calls . . . . .	£588,843	0	0
Interest . . . . .	2,660	4	1
	£591,503	4	1

*Payments.*

Expended in raising the capital, procuring the Act of Parliament, &c. . . . .	39,040	16	6
Land and compensation, including charge for surveying and valuing . . . . .	158,760	2	2
Conveyancing and law charges . . . . .	2,994	10	9
Cuttings and embankments, bridges, culverts, and stores for the same, fencing, draining, &c. . . . .	198,965	9	0
Iron rails, chairs, and sleepers . . . . .	78,050	3	8
Engines, waggons, implements and tools, and stores for the same . . . . .	56,192	4	0
Temporary buildings . . . . .	4,276	3	4
Surveying and engineering . . . . .	12,200	18	5
Salaries, wages, rent and taxes, printing and stationery, postages, travelling, and all other incidental expenses . . . . .	9,060	16	3

Directors, expenses and fines, from the commencement of the undertaking . . .	1,550	0	0
	561,091	4	1
Cash in hand . . . . .	24,412	0	0
Funded property in 3 per Cent. Consols, invested as required by the 14th clause of the Act of Parliament . . . . .	6,000	0	0
	30,412	0	0
	<u>£591,503</u>	<u>4</u>	<u>1</u>

*Report.*

The Directors have, on this occasion, to report to the proprietary, that although, owing to the extreme wetness of the season, the progress of the work has not been so rapid as it would have been under a more favourable state of the weather, yet it has been on the whole satisfactory. On some parts of the clay district, where gravel for the roads could not be obtained, the works have been altogether suspended; but this has only been the case where the quantity still remaining to be done is comparatively small, and where the suspension of the work will not protract the opening of the line beyond the time stated at the last General Half-yearly Meeting.

Many alterations and improvements in the line have been already carried into effect by the consent of the land owners, and in that most important case, the deviation to avoid the Popham Tunnel, the Directors have good reason to hope for the unanimous concurrence of the landed proprietors. Owing, however, to some of the estates being entailed, and others being Church property, the present possessors are not able to convey the land to the Company without the sanction of the Legislature, and the Directors have therefore availed themselves of the authority given them by the resolution of the last general half-yearly Meeting, and have presented their petition for leave to bring in an amended Bill. In the Act now applied for, it is proposed to obtain a power to enable the Company to raise an additional capital of 500,000*l.*, a sum which the experience of the last six months has shewn will be absolutely necessary to effect the completion of the line, and furnish the locomotive engines and carriages, which were not included in the original estimate.

The principal causes for this increased outlay are the large sums paid for the land, exceeding the estimate by about 150,000*l.*, the greatly augmented price of labour, and also of iron, and all other materials.

The rails which are now intended to be laid down, being heavier than those originally contemplated, whereby the Directors hope to

reduce to its minimum the cost of maintaining the road, when it shall be opened for traffic, also obviously increases the first expenditure.

In the month of December last, the Lancashire proprietors in this railway, appointed a deputation from among themselves, of three gentlemen, to inspect the line and view the state of the works. A measure of this kind, originating with so large and intelligent a section of the proprietors, could not fail to be agreeable to the Directors, and they therefore not only gave instructions to their different officers to afford every information, but several of their own body accompanied the deputation along the entire line of the railway. The Directors have reason to believe, that the result of that inspection has been to give increased confidence in the undertaking to the gentlemen forming the deputation, two of whom having consented to accept the vacant seats in the direction, will this day be proposed to you for nomination.

Mr. Giles having resigned his appointment of engineer to this Company, the Directors have secured the services of Mr. Joseph Locke, the engineer, under whose able superintendence the Grand Junction Railway (from Birmingham to Liverpool) is just about to be completed.

The petition for the Portsmouth Junction Railway has been presented to Parliament; and although some opposition to this measure is threatened, yet the Directors hope, that more mature reflection will lead to a conviction of the public utility of the undertaking, and that it will receive the sanction of Parliament.

The Directors are happy in being able to state their belief, that the promoters of the two rival lines which were projected to run from out of the Southampton Railway, by way of Salisbury to the West of England, will come to an amicable arrangement, by which their united influence will be devoted to a measure important to the interests of the Southampton Railway Company.

The Directors will give to these undertakings all the support in their power, and they hope for the energetic assistance of the proprietary.

In conclusion, the Directors feel assured, that although the cost of this railway, as well as of almost all others, will be greater than was at first estimated, yet the traffic on the line will be ample, and will secure for its proprietors a most satisfactory return.

By order of the Court of Directors,

WILLIAM REED, *Secretary*.

Resolved—That in the application to Parliament for an amended Act, authorized by the general half-yearly Meeting of the 30th of August last, the Directors be further authorized to apply for power to raise an additional capital of 500,000*l*.

The Directors having declared one hundred and seventeen Shares forfeited by reason of non-payment of calls, it is—

Resolved—That the forfeiture of the said one hundred and seventeen Shares be confirmed, and that they be sold according to the provisions of the Act of Parliament.

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### NORTH MIDLAND RAILWAY.

EXTRACT FROM THE FIRST HALF-YEARLY REPORT. Geo. Carr Glyn, Esq., in the Chair. London, 8th February, 1887.

The works connected with the Clay Cross Tunnel, necessarily attracted the attention of the Directors, and they have much satisfaction in stating, that, under the judicious advice of the Messrs. Stephensons and Mr. Swanwick, a contract has been concluded with competent parties, upon favourable terms, which the Directors feel convinced will ensure the expeditious and certain execution of the work.

The plans and specifications for two other contracts for works adjoining the Clay Cross Tunnel, to the extent of eleven miles, are in a state of forwardness, and will shortly be advertised.

The important negotiation with the freemen of the borough of Derby, alluded to in the last Report, has been brought to a most satisfactory conclusion.

A site has been in consequence selected for the station of the railway at that place, which is well adapted to promote the general interests of the undertaking, and to contribute to the local advantages of the town of Derby. It effects an immediate and direct communication with the Derby and Birmingham and Midland Counties Railways.

The agreements for the purchase of lands are proceeding with all possible despatch. Several have been concluded, and the Directors have hitherto met with no serious impediment in the progress of their negotiations.

Application is proposed to be made to Parliament in the present session for power to deviate from the line of railway in the parish of Duffield, extending through the town of Belper, which will effect a material improvement in the line, by doing away with the only objectionable curve that previously existed upon it; and also avoid the inconvenience which was apprehended by the inhabitants, from the mode in which it was proposed to pass the town. It is intended to take power at the same time to make other unimportant alterations in the line in the parishes of South Wingfield, Chesterfield, and Beighton.

Power is also proposed to be taken to make the branch railway in the parish of North Wingfield, which formed part of the plan of last year, but which was then abandoned on account of not having been taken up in sufficient time to comply with the standing orders of Parliament. And also to make a branch to the



Butterley Iron Works near Alfreton. These branches are expected to open an important coal and mineral district, and consequently to increase the traffic on the main line.

It being necessary to apply to Parliament to effect the foregoing objects, the Directors considered it desirable to embrace the opportunity of applying for power to purchase some additional land or buildings at the termination of the line in Leeds, which will enable them to afford increased accommodation in the station, and also to make convenient approaches to it from the town.

The second instalment of 5*l.* per share has been paid upon 13,281 shares, leaving a deficiency on 1,719 shares, which chiefly arises from the difficulty of inducing parties who have purchased scrip receipts to send them in for registration. The consideration of this circumstance induces the Directors to postpone calling upon the Meeting to act upon the powers invested in it for the forfeiture of these shares.

The proprietary is highly respectable, and affords an undoubted proof of the estimation in which this undertaking is held by the public.

By the accounts which will be laid before the Court up to the 31st of December, 1836, it will be seen that the sum of one hundred and eleven thousand four hundred and twenty pounds one shilling remains at the disposal of the Company.

*General Account of the Receipts and Disbursements of the North Midland Railway Company to 31st Dec. 1836.*

Dec. 31st. 1836.	Cr.	Shares.	£	s.	d.	£	s.	d.
By cash received for 1st call at 5 <i>l.</i>								
per share . . . . .		14,980	74,900	0	0			
„ Cash received for 2d call at 5 <i>l.</i>								
per share . . . . .		12,761	63,805	0	0			
„ Interest . . . . .			554	9	10	139,259	9	10
<i>Dr.</i>								
To payments before the Act was obtained . . . . .			37,250	8	8			
„ Disbursements, in addition upon obtaining the Act, not included in the above amount, as per Abstract A . . . . .						509	18	10
„ Disbursements since the Act was obtained as per Abstract B . . . . .						427	10	4
„ F. Swanwick, resident engineer at Chesterfield, on account . . . . .						250	0	0
„ Disbursements by the Leeds Committee . . . . .						271	4	0
„ Paid Messrs. George Leather and Son, for survey north of Leeds, in January and February, 1836. . . . .						325	7	0
						<hr/>		
						39,034	8	10
To cash at the disposal of the Company . . . . .						£100,225	1	0
and second call to be received on 2,239 shares . . . . .						11,195	0	0
						<hr/>		
						111,420	1	0

*Abstract A.*

Sundries, consisting of travelling expenses, agencies, &c. . . .	£147 19 0
Law charges for special agreement, per Freshfield and Co. . . .	56 17 3
Ditto. Pemberton and Co. . . . .	18 5 8
Surveying and witnesses' expenses, Grainger and Co. . . . .	192 3 11
I. K. Brunel . . . . .	56 15 0
Mr. Perrin, witness . . . . .	16 0 0
Mr. Branscomb, ditto . . . . .	21 18 0
	<hr/>
	£509 18 10

*Abstract B.*

Office charges, rent, salaries to secretaries, clerks, and petty expenses . . . . .	363 11 4
Stamping press . . . . .	30 15 0
Common seal . . . . .	20 14 0
Maps, &c., sent to Leeds . . . . .	12 10 0
	<hr/>
	£427 10 4

Not exceeding 2,160*l.* to be appropriated for the services of the Directors.

## GREAT NORTH OF ENGLAND RAILWAY COMPANY.

Report of the Directors to the General Meeting of Shareholders,  
convened February 1st, 1837.

In framing a Report upon a work of such magnitude as the Great North of England Railway within a very few months after the passing of the Act for its formation, it cannot be expected that the Directors should have much to communicate of actual progress in the works.

Their time has been hitherto unavoidably occupied (though they trust with the greatest benefit to the Company) in negotiating with landowners, where the line of Railway was considered as finally settled, in preparing and advertising for contracts upon those portions of the line, especially wherever the magnitude of the works seemed to call for their prompt and vigorous execution—in earnest deliberations upon suggested improvements of the line, particularly at the crossing of the Tyne, and in the needful preparations for the application about to be made to Parliament for powers to carry the railroad forward to York, and to connect with it, by various branches, several important towns of the North Riding.

It need hardly be stated that this last subject must continue to be, till accomplished, a matter of paramount interest to the Company.

Even if these most important preliminaries had not fully engrossed the attention of the Board of Directors, and if it had been practicable to complete before this time any contracts for the execution of works, the extreme rigour of the season would have rendered it hardly expedient to break ground in such adverse circumstances.

The Directors will now proceed to state more in detail what has been done by them, under the several heads before referred to.

*1st. Negotiations with Landowners.*

Agreements have been concluded with several proprietors in the county of Durham.

Treaties either for reference or other amicable adjustment are in progress with others, and important advances have been made in negotiation with various landowners on the Yorkshire portion of the line.

Upon the whole, the Directors conceive that they are justified in reporting favourably of the spirit in which they have been generally met by the landowners.

*2d. Preparations and Advertisements for Contracts.*

The natural obstacles to be surmounted in the formation of the way for nine miles, between Chester Burn and Thinford-mill Lane (although by no means constituting serious engineering difficulties), appeared to demand the earliest and best attention of the Directors; and to this they accordingly applied themselves.

The time for receiving tenders for this work expired yesterday, and the Directors have the satisfaction to report that they have received offers for the execution of this great work, in some instances within the estimate of your engineer, and uniformly with an engagement to complete it in the time fixed by the Directors, which offers are now under the consideration of the Board.

Contracts for the fencing of these nine miles have been completed; and advertisements for tenders to furnish the stone blocks, and to construct that most important work the Shincliffe viaduct, have been for some time before the public, and will be finally received on the 21st instant.

*3d. Deliberations respecting Improvements on the Line.*

The vast interest excited, and the various conflicting opinions expressed upon the question of the line to be adopted in the continuation of the railway northward to Edinburgh and Glasgow, must be well known to all who have taken an interest in the Great North of England Railway.

The decision of that question being in other hands, the Directors have thought it their only safe course to abstain from appearing in it at all in the character of partisans, feeling assured from the importance of the measure, and the interest excited, that one or other of the projected lines will eventually be executed. But the mode of crossing the Tyne is a matter intimately connected with that question, and the Directors, deeply impressed with the great importance of fixing most advantageously the point of crossing that river, and the level at which it should be traversed, have invited other companies equally interested in the matter with themselves, to unite with this company by means of deputations from the several Boards of Directors, and of conferences among the engineers of the respective companies, to institute a careful investigation of the whole question.

These conferences are still in progress, and the mode in which the connexion of our railway with Newcastle and the parts north of the Tyne shall be eventually formed, must depend, in some measure on their result. But should there be any hesitation on the part of those companies to meet this question on its real merits, which they do not at all anticipate, the Directors have taken the

necessary steps to insure the accomplishment of this most important object at the point and level that will be most conducive to the interests of the Great North of England Railway Company.

4th. *Preparations for Application to Parliament for the York line.*

The objection made on the part of a large proprietor of lands to the Parliamentary line from Croft to York, induced the Directors to cause fresh surveys to be made of two different lines, one to the eastward of the great turnpike road leading to York, the other, west of the Parliamentary line, and connecting with the York and North Midland Railway, near Tadcaster. The Report of the engineer (though by no means unfavourable to the latter in an engineering point of view) was such as to induce the Directors to adhere to their old Parliamentary line. The favourable negotiations with the landowners on this part of the way have been already slightly adverted to; and the Directors have no doubt of obtaining the Act for this portion of the line in the present session of Parliament. The deep importance to the company of the speedy completion of the line to York, is fully set forth in a document printed by order of the Board of Directors on the 10th ultimo. And which is probably in the hands of all parties interested in the measure; and it only now remains for the Directors to express their unabated confidence in the success of the undertaking.

(Signed) GEO. H. WILKINSON, *Chairman.*

## BIRMINGHAM AND GLOUCESTER RAILWAY.

### *Half-yearly Report, Feb. 1, 1837.*

THE directors of the company have the satisfaction of presenting to the proprietors their first half-yearly report, and it is with pleasure they communicate the promptness with which their call upon the shareholders for the first instalment has been answered; at a time when the general pressure upon the monied interest has affected, directly or indirectly, almost all classes of persons, and necessarily tended to create some apprehension that the calls might not be responded to by a ready payment. Making due allowance for the unavoidable delay necessarily attendant upon the conversion of scrip into shares, with a just regard to circumspection as a safeguard to the legal proprietor, the capital has been forthcoming with an alacrity which leaves no doubt of the whole being obtained at the various periods at which it may be required. The funds received have enabled the directors to liquidate the demands for compensation, and to pay for the shares of the tram-road between Gloucester and Cheltenham, purchased jointly with the Cheltenham and Great Western Union Railway Company; and it is a source of great pleasure to your directors to report, that the purchase of those shares has not only been otherwise than injurious to the interests of this company, but that it is in itself an improving and beneficial investment, paying at this moment  $6\frac{1}{2}$  per cent. upon the purchase money.

Your directors have also to report, that the engineer of the company has furnished, at the respective periods originally promised, the plans and specifications for the contracts for works. They regret that it is not in their power to communicate a corresponding progress in the purchase of the land necessary for carrying the same into effect immediately; but they feel assured that, when the circumstances are fully known to the proprietary, they will be satisfied that it would have been most imprudent and impolitic to have conceded to the enormously exorbitant demands of some few proprietors of land, in the outset of the undertaking—which might, perhaps, have obtained ephemeral *écât* for the directors, by enabling them to commence the works without delay, but would have been highly injurious to the interests of the shareholders. It has so happened that the most valuable portion of the land in the immediate neighbourhood of Birmingham appertained to the first contract; and, although your directors were anxious to proceed with becoming liberality, and to avoid, if possible, the onerous alternative of resorting to the compulsory powers granted to them by the Act of Parliament, and have therefore, continued their negotiations to an inconveniently protracted period—they felt that they should be sacrificing the interests of their proprietary, if they gave way to demands far exceeding the just and most liberally calculated value of the land required. This disappointment, and vexation has placed them in the unpleasant position of not being able to communicate to you the commencement of the first contract; but they conceive that it was of the last importance to resist such demands, which, if complied with, would have formed a dangerous precedent for the whole of the land required, and they have, therefore, reluctantly resolved on resorting to a jury in two cases. The legal proceedings are in progress, and there can be no doubt of a decision in sufficient time to commence the work at a fitting season in the spring. The superintendent has completed the purchase of some portions of the land, and on terms satisfactory and just; and it is presumed that the means now resorted to will prevent further impediment to the progress of the works. The engineer has delivered in his plans and specifications for the second contract, and the interim has been usefully and judiciously employed in sinking shafts for the tunnel at Moseley, and constructing drains, which will materially forward the operations of the contractors, and also enable the engineer to form a more correct estimate for the terms of the contract. The whole of the drawings and specifications for the first and second contracts being therefore now ready—the former commencing at Camphill, Birmingham, and extending to Moseley, the latter commencing at Moseley and extending nearly to Bredon's Cross, including some of the heaviest work on the line, a portion of the tunneling, and the greatest average proportion of bridges—it is hoped that the whole of this work will shortly be in vigorous operation. Considerable progress has also been made in preparing

Your directors, actuated by an anxious desire to place the future management of this great undertaking on the most effective footing, have given deep consideration to the propriety of making such alterations in the present management as would, in their judgment, secure many and permanent advantages to the company. They, therefore, introduced clauses in the new bill, reducing the number of directors from eighteen to twelve, and for conducting the affairs of the company under one committee of management—the place of residence of the directors to be unrestricted, but the places of meeting to remain under the same regulations as at present. The directors have also to submit the balance sheet, showing the financial situation of your affairs up to the 31st of December, 1836, and they trust the proprietors will feel satisfied, considering the extensive payments which have been made, and that large sums will be receivable so soon as the claims for the registration of a considerable portion of scrip can be legally adjusted, that the concerns of the company are in a very flourishing condition, and that all the favourable prospects attending this undertaking at its commencement will, in due time, be realized.

*General Account of the Receipts and Disbursements of the Bir-  
mingham and Gloucester Railway Company, Dec. 31, 1836.*

Cr.				Dr.
1836.	£	s.	d.	1836.
Dec. 31st,				Dec. 31st,
To expenditure,				By calls,
as per statement				Ten per cent.
below . . .	31,428	7	10½	on capital . . .
Balance at the				£95,000 0 0
disposal of the				Due from sun-
Company . .	42,149	7	8½	dries . . .
				22,430 0 0
				<hr/>
				By sundry per-
				sons . . .
				306 16 0
				By interest on
				banker's ba-
				lances . . .
				684 7 3
				By ditto call . .
				16 11 10
				<hr/>
				700 19 1
				<hr/>
	73,577	15	7	£73,577 15 7

Parliamentary and law charges . . . . .	£10,004	6	0
Engineering and surveying . . . . .	8,828	0	0
Compensation . . . . .	6,502	17	4
Traffic . . . . .	1,873	2	2
Deputation expenses . . . . .	1,231	19	6
Direction . . . . .	923	19	11
Printing and advertising . . . . .	255	14	2
Stationery . . . . .	174	13	1
Furniture and fixtures . . . . .	284	10	11
Office charges and salaries . . . . .	1,312	4	9½
Incidental expenses . . . . .	37	0	0
	£31,428	7	10½

## FIRST REPORT OF THE COMMISSIONERS

APPOINTED TO INQUIRE INTO THE MANNER IN WHICH RAILWAY COMMUNICATIONS CAN BE MOST ADVANTAGEOUSLY PROMOTED IN IRELAND.

### *Commission.*

WILLIAM the FOURTH, by the Grace of God, of the United Kingdom of Great Britain and Ireland, King, Defender of the Faith, &c.

To our trusty and well-beloved Thomas Drummond, Esq., Under Secretary of our State in that part of our United Kingdom of Great Britain and Ireland called Ireland; John Fox Burgoyne, Esquire, Colonel in our army; Peter Barlow, Esquire, Professor of Mathematics in our Royal Military Academy at Woolwich; Richard Griffith, Esquire, greeting. Whereas an humble Address has been presented to us by the Lords Spiritual and Temporal in Parliament assembled, requesting that we would be graciously pleased to appoint persons of competent authority to consider and report upon the principal lines of communication in Ireland with reference to the comparative advantages and facilities they afford for the construction of railways, and that with a view to ascertain the best lines between any of the principal places in Ireland which it may be advisable to connect by railways, and for which works joint stock companies may be willing hereafter to apply to Parliament, we would be graciously pleased to direct such assistance to be afforded by the Board of Public Works towards a general survey of such lines as to us might seem fit. Now know ye, that We, reposing great trust and confidence in your zeal and ability, have authorised and appointed, and do by these presents authorise and appoint you, the said Thomas Drummond, John Fox Burgoyne, Peter Barlow, and Richard Griffith, or any two or more of you, to be our Commissioners for the purposes aforesaid. And our will and pleasure is, that you consider, *first*, as to a general system for railways in Ireland, in such manner, either by causing surveys

to be made of the leading lines, or otherwise, as may best serve to guide the Legislature in the consideration of the projects that may be brought before it. *Secondly*, as to the best mode of directing the development of said new and important means of intercourse to the channels whereby the greatest advantages may be obtained by the smallest outlay, taking into consideration not only the existing means which the country presents, but those which may be anticipated from the resources which may in future be developed. *Thirdly*, that you should make inquiry as to the port or ports on the west or south coast, from whence the navigation to America may be best carried on by steam or sailing vessels; and that you should investigate particularly the facilities for the construction of lines of railroad across Ireland to such port or ports in connexion with the greatest possible collateral benefits to internal communications. And, *fourthly*, that you should inquire into all such other matters as may appear to you essential to the useful prosecution and result of your investigations. And for the purpose of enabling you, our said Commissioners, to form a sound judgment on the premises, we do hereby authorise and empower you, or any two or more of you, to obtain information thereupon, by the examination of all persons whom you may judge most competent, by reason of their situation, knowledge, or experience, to afford it, and also by calling for all documents, papers, and returns, which may appear to you, or any two or more of you, calculated to assist your researches. And we do also give and grant unto you, or any two or more of you, full power and authority, when the same shall appear to be requisite, to administer an oath or oaths to any person or persons whatsoever to be examined before you, or any two or more of you, touching or concerning the premises. And we do hereby command and require you, or any three of you, to report to us in writing, under your hands and seals, on or before the 10th day of April, or sooner, if the same can reasonably be, your several proceedings, by virtue of this our Commission, together with your opinions on the several matters which you are hereby required to take into your consideration. And we will and command that this our Commission shall continue in full force and virtue, and that you our said Commissioners, or any two or more of you, may from time to time proceed in the execution thereof, and of every matter and thing therein contained, although the same be not continued from time to time by adjournment. And we hereby command all and singular our justices of the peace, sheriffs, mayors, bailiffs, constables, officers, ministers, and all others our loving subjects whatsoever, as well within our liberties as without, that they be assistant to you and each of you in the execution of all these presents. And further, we do hereby appoint our trusty and well-beloved Harry David Jones, Esq., Captain in our Army, to be Secretary to this our Commission, whose service and assistance we require you to use from time to time, as occasion may require.



In witness whereof, we have caused these our letters to be made patent.

Witness ourself at Westminster, the 20th day of October, in the seventh year of our reign.

By Writ of Privy Seal,  
(Signed)

EDMUNDS.

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*First Report.*

To the King's Most Excellent Majesty, &c., &c., &c.  
WE, the undersigned Commissioners appointed by your Majesty, under date the 28th of October, 1836, to inquire into the manner in which railway communications can be most advantageously promoted in Ireland, humbly beg to lay before your Majesty this our First Report, which we present thus early in obedience to your Majesty's commands.

We regret that, notwithstanding the strenuous efforts which we have used, we cannot, at the present moment, enter into such details, or furnish such documents, as would enable others to form a judgment on the measures which, in our opinion, it might be desirable to sanction in reference to this very important subject. We have, however, collected a great mass of information which we are arranging; and we believe that the principles on which we are pursuing this inquiry will lead to practical and beneficial results.

When the very great importance of the matter submitted to our investigation—the valuable and, in many instances, conflicting interests which it involves—and the vast public injury which would arise from a false step at the commencement of a system that may produce a total change in the internal communication of this country—are considered, we are persuaded that the inconvenience of a short delay will be deemed preferable to the hazard we should run of recommending, upon an incomplete view of the subject, plans or projects which we might afterwards see reason to modify or alter. We hope to be able to terminate our inquiry and to present a full Report in time to admit of the Legislature coming to a decision during the present session, on the measures which it may be desirable to sanction.

We proceed to explain the course which we have pursued, and, in some degree, the progress which we have made in this investigation.

In commencing our proceedings, we looked at the country with reference to the amount, distribution, and employment of its population; to the extent and value of its traffic, and the channels through which that traffic is at present carried on; to the size and position of its principal towns: their present communication; the number of public conveyances, and of the passengers that now travel by them. We looked at the country in reference to its

physical features, and the facilities and impediments which these offer to the construction of railways; and also to the comparative fertility of soil: the present produce; and the capability of improvement of its several districts.

On all these points we took immediate steps to collect the most accurate information which could be obtained from existing documents, public departments, and from those private individuals who possessed peculiar means of knowledge through the nature of their pursuits and occupations.

The Customs and Excise have afforded us valuable assistance; the Chairmen of both Boards having directed their officers to prepare certain returns relative to the trade of the country, which we shall be able to give in our Second Report. We have likewise been much assisted by the constabulary, who, under the directions of Colonel Shaw Kennedy, have procured for us much useful information respecting the inland traffic in most parts of Ireland. It is due to many intelligent individuals of that service to bear our testimony to the zeal and efficiency with which the inquiries intrusted to them have been prosecuted. We have also received, in answer to circulars addressed to persons engaged in trade, some valuable communications; and in those places and on those points where accuracy was most important, we have employed individuals accustomed to statistical inquiries to verify and extend the information obtained through these various channels.

With regard to the number of passengers travelling by coaches and cars, returns are preparing under the direction of the Post-Office, and by Messrs. Purcell, Bourne, and Bianconi, the principal proprietors of public conveyances in Ireland. These returns will be useful, not merely as exhibiting the existing intercourse, but as exemplifying, particularly by the experience of Mr. Bianconi, the proprietor of a very extensive establishment of stage-cars in the south of Ireland, the increase of intercourse which follows increased facility and diminished expense of communication.

At the commencement of our inquiry, the want of a map of Ireland on which lines might be laid down with some degree of accuracy, offered a very serious impediment to our progress. There did not exist any on which the relative positions of leading towns, still less of inferior objects, were marked with the precision which our purpose required; and as to the features of the country, the delineation of them was, for the most part, extremely incorrect, often purely fanciful. This would have occasioned very considerable embarrassment, and increased the expense, as well as prolonged the period of our inquiry, had not the deficiency been supplied through the active co-operation of the ordnance survey department for Ireland, under Colonel Colby. The survey of nine counties out of the thirty-two has been completed, and that of several others is in a state of forwardness. Colonel Colby, at our request, caused a diagram to be made of the whole of Ireland from the great

triangulation, and a map to be compiled from the already completed portion of the ordnance survey, and the best county maps which could be obtained. Many of these maps are extremely defective and inaccurate, particularly in showing the relative positions of the towns; but this material imperfection has, in a great measure, been removed by means of the fixed points of the great triangulation.

The preparation of the map was intrusted to Lieutenant Larcom of the Royal Engineers, by whose unremitting exertions and ability the object has been effected; and we are now in possession of a map of Ireland far superior to any hitherto constructed, and which, even for general purposes, will be a most valuable acquisition to the public, during the period that will intervene before the ordnance survey shall be completed. The labour and energy required to complete such a task in so short a time can be appreciated only by those who are conversant with the nature of similar operations.

Mr. Griffith's unpublished Geological Map of Ireland—a copy of which will accompany our next Report—has proved very useful and interesting in the prosecution of our inquiries.

The great limestone districts form one of the most important and characteristic features of this country. Besides indicating superior fertility of soil, they present universally the greatest facilities to the engineer. Being generally free from elevated ridges of ground, they present peculiarly favourable levels, and furnish excellent materials for the construction of works. Hence, in addition to the knowledge which this map affords of the geological structure and mineral products of the country, it has been of material assistance to us in pointing out those rich and populous districts which it would be at once most desirable and most easy to traverse by railways.

In order to ascertain how far the objects which we had in view might be promoted by the previous inquiries of others, we applied for and have obtained plans and reports explanatory of the several projects which have been as yet brought before the public. We have also had the benefit of personal explanations from such of the engineers and principal promoters of those undertakings as we could meet with in Dublin.

As the investigation proceeded, we were enabled gradually, and, as we trust, on just and sure grounds, to determine the limits within which the principal lines of railway should, in our opinion, be confined. And we then directed a detailed and particular examination to the districts contained within those limits.

We have been able to avail ourselves of the services of two eminent engineers, Mr. Vignoles and Mr. M'Neil, a statement of whose proceedings shall accompany our next Report. These gentlemen have been for some time employed in ascertaining, by local examination, how far our propositions are practicable,—in what degree they are adapted to the attainment of our objects,—and whether or not it might be desirable to alter or modify them in any respect. Their inquiries on many points have been brought

to a close, and they have made considerable progress towards completing what remains of the task assigned to them.

We are also pursuing a course of inquiry with regard to the principles which should be observed in the construction of railways. We shall endeavour to distinguish between those which ought to be enforced by legislative enactment, and those which might be left to the fancy or sagacity of the directors and managers of companies.

Our consideration has been directed to the effects of gradients and curves, of the width of the lines, of the weight and strength of the rails, and of various other details of construction; effects which have not as yet been clearly ascertained, but on which the stability and economy of these works greatly depend, and which must materially influence the return on the capital to be expended in future undertakings of this kind. On all these points there can be little doubt that much knowledge yet remains to be acquired from future experience. But much has been already learned since the opening of the Liverpool and Manchester line, and many improvements have been introduced tending in part to increase the permanency of the works, and in part calculated to diminish the general expenditure. It shall be our endeavour to collect these important practical results, in the hope of aiding the progress of improvement in the construction and working of future railways.

We have also on this subject communicated with the principal railway companies in England, and it is but justice to the directors and managers of those companies to acknowledge the readiness with which they have answered our inquiries, and the valuable information and many useful suggestions which we have received from them.

In obedience to your Majesty's commands, we have entered into the examination of a very important and interesting question,—the establishing of a steam communication with America from the west or south-west coast of Ireland.

In the present state of steam navigation, a voyage to New York from any part of Great Britain has been considered by many to be beyond the range of a steam-vessel; whilst others are of opinion that such a voyage, though perhaps impracticable from Great Britain, might be effected from the western coast of Ireland; and that, so far as regards passengers and the transmission of letters and light goods, such an intercourse might be established and conducted with great advantage. We are aware that steam-vessels of a large size are now fitting out at Liverpool and Bristol for the purpose of attempting the direct voyage to New York; and we shall abstain at present from expressing an opinion on the relative advantages of different ports; but shall merely observe, that we have looked at the question, as regards Ireland, thus—admitting that it is found advantageous to start from a port as far to the westward as possible—in what direction and to what port should the railway for

effecting this object traverse Ireland? In this view of the question the main consideration would be a rapid and convenient transit to the port of embarkation; and to that object the means which such a line would afford, of increasing internal traffic, must be regarded as altogether subordinate. But on the other hand, reversing the supposition, and regarding the promotion of inland intercourse as the primary, and the establishing a steam navigation with America as a secondary and perhaps remote object,—what line would for such a purpose be deemed the most eligible? If we have succeeded in coming to just conclusions on both these points, we shall be enabled to say whether the two purposes might not be essentially attained through the medium of one common line.

In pursuance of our instructions, we have also considered in what manner the most rapid and certain communication between London and Dublin might be effected. We are not as yet in possession of sufficient information respecting the different projects advanced for accomplishing this object, to venture an opinion on their relative merits. All railway projects in Ireland will of course be greatly promoted by the establishment of such a communication, but advantageous intercourse with America by steam from the west coast of Ireland cannot be contemplated without it.

Having thus explained the course which we have followed, and, to a certain extent, the progress we have made, we proceed to lay before your Majesty some of the general opinions which we have formed during this investigation.

The first and most important conclusion at which we have arrived is, that the intercourse in Ireland is not at present, nor is likely, for many years to come, to be of that constant and active kind which would justify the expectation that railways spread over the country in distinct lines from town to town, would prove remunerative undertakings. In that respect we fear they would be total failures; and unless remunerative, not only would such undertakings be directly injurious to the community, by the amount of capital taken out of productive circulation, but the losses and disappointments of those embarking in them could scarcely fail to occasion a general want of confidence, which would greatly impede if it did not prove altogether fatal to the most legitimate and well-founded enterprises.\*

Deeply impressed with this conviction, we would humbly but earnestly suggest that the most searching inquiry should be made into the grounds on which these separate companies rest their hopes of success, before they obtain the sanction of the Legislature. We believe that in the greater number of instances the most important public objects which they all profess might be accomplished at a much less expenditure of capital, and at a very

\* Short lines, such as that between Dublin and Kingstown, connecting large and populous towns with the adjacent harbours or watering-places, will of course be exceptions.

moderate sacrifice of time and space, as regards individual places, by a well-combined and judicious system of railways, in which the joint traffic of many places and districts should be made to pass to a great extent over one common line, and where the greatest general accommodation should be attained at the smallest outlay. We shall not say, that such a system alone can be profitable; but we do assert, without fear of contradiction, that, looking to the present circumstances of this country, it affords by far the most reasonable hope of a fair return on the capital expended. If economy of expenditure is necessary in England, it is indispensable in Ireland, where capital is less abundant, intercourse more languid, and traffic less active.

There are also circumstances peculiar to railways worked by locomotive steam-engines which impose an additional necessity for circumspection. On railways where animal power is the motive agent, the profit will be nearly proportioned to the traffic; but where steam is employed small weights are moved at a great and ruinous expenditure of power, and it is not till the traffic becomes very considerable, that the use of steam becomes profitable, and it is only when the intercourse is active and abundant that the superiority and economy of steam are fully experienced. We believe that the contemplation of its wonder-working power under such circumstances has caused the disadvantages of using it in less favourable cases to be very much overlooked. Hence the importance and necessity of endeavouring to devise a system that shall combine and concentrate the traffic and intercourse of many places. A small increase of distance adds but little to the expense of conveyance, and when the transit is rapid, still less to the time.

The selection of such great public lines ought not to be left to private parties or companies. There are many interests involved demanding the most impartial consideration; and it is not by selecting a line to some large town, and conferring upon it the imposing title of a Grand Trunk line that the object for which we are contending is to be accomplished. We are not insensible to the danger of fettering commercial enterprise; but parties who promise benefits, and seek privileges in return, have no reason to complain if their capability of fulfilling their engagements to the public be rigidly scrutinized. And further, if the inquiry be pursued with a view to determine whether the promised advantages may not be obtainable at a less expenditure of the national capital than in the manner which they propose, sufficient is known of the mode in which many railway schemes are got up, to justify the adoption of every precaution to protect the country against those which it may be profitable to speculators to project, but ruinous to shareholders to execute.

The past history of public works in this country is not calculated to excite any very sanguine expectation on the part of the spe-

culative capitalist. Instead of being referred to as encouraging examples of successful enterprise, they can only be pointed out as beacons to warn him against embarking in similar undertakings.

It is because an opportunity now offers of removing the injurious impression produced by these failures, and of introducing a system of communication capable of conferring, under due precautions, vast benefit on this country: it is because we are strongly impressed with the conviction that a false step at the commencement might deprive the country for many years to come of advantages now within its reach; and because, in regard to this important matter, we dread the consequence of indulging in extravagant expectations, and of rushing into inconsiderate speculations—that we would humbly but most earnestly express a hope that the sanction of the Legislature may not be given to any great line of railway in Ireland till the most careful inquiry has shown that the statements of its promoters are grounded on sound views and accurate data, and that of all others it is the best adapted to effect the public objects for which it is proposed, and the most likely to afford a profitable return on the capital expended in its execution.

But whilst we recommend the utmost caution in deciding upon individual projects, we would also humbly represent to your Majesty the necessity of affording peculiar encouragement to the prosecution of public works in Ireland.

The great natural capabilities which the country presents, the little exertion that has yet been made either from public or private sources to develop them, the amount of the population so far exceeding the ordinary demand for labour, and, on that account, exposed to periodical sufferings of the most harrowing and deplorable description—are circumstances fully ascertained and acknowledged. It would appear, therefore, just and reasonable, whether regarded as a question of policy or of duty, that while effective means are taken to check and avoid deceptive speculations and needless expenditure, every possible aid and facility, consistent with prudence and the interest of the United Kingdom, should be extended to public undertakings, the utility of which shall have been clearly established.

Among the obstacles which an enterprise, such as we are immediately considering, must encounter at the very commencement, are; the delay interposed, and the enormous outlay that must take place before even a spade can be put into the ground towards its execution. This delay and expenditure are at present unavoidable; for they arise in a great degree from the provisions of the new standing orders in Parliament, which must, in every instance, be strictly and fully complied with.

The Legislature has deemed it right to require plans to be lodged, and notices, to a very great extent, to be served; and when these directions have been observed, an interval of twelve months must afterwards elapse before application can be made for leave to

bring in a railway Bill. The standing orders which relate to these objects were framed chiefly with a view to the protection of the owners and occupiers of property likely to be affected by such undertakings. But there are few establishments in Ireland which could be injured by the operation of such works, whilst property in general, and more especially that in their immediate neighbourhood, far from being deteriorated, would be greatly increased in value. We therefore humbly suggest that it may be desirable to examine whether some of those standing orders might not be relaxed, simplified, or dispensed with, as far as regards the introduction of Bills for Ireland.

In the progress of this inquiry, our attention has been directed to the manner in which railway Bills are prepared, and to the great inconvenience and expense which arise from their length and complexity. It would tend much to remove this objection if all the provisions which are common to every measure of this kind, and, in fact, constitute the general principles on which it is the manifest intention of the Legislature uniformly to ground its enactments with regard to railways, were embodied in one general Act, applicable to every case. If this were done, a Bill for a particular railway would only be required to set forth its own specific features and provisions, which might be contained within a very small compass; and thus, not only would legislation on these subjects be rendered much more simple, but the preliminary expenses, which now fall so heavily on the projectors, would be greatly reduced.

Having now pointed out the advantages which might naturally be expected to result from the encouragement of well-founded enterprizes of this kind in Ireland, it is right that we should advert, on the other hand, to the protection which the public would be entitled to demand against abuse of the power usually conferred on private railway companies.

It is manifest that wherever this superior mode of intercourse shall be established, it will supersede all others, both as a conveyance for passengers and with respect to many other most important purposes. A monopoly will be consequently established, as far as those purposes are concerned; and hence great evils may arise from committing, without control, the management and regulation of railroads to the power and discretion of individuals or companies, whose chief consideration would be their own private profit and advantage.

Among the most obvious of the evils to be apprehended we may enumerate the following:—

1stly,—The charges might be exorbitant.

2dly,—The speed might be reduced to a rate not much surpassing that of ordinary road travelling.

3dly,—The passengers might be exposed in various ways to



inconveniences and irregularities ; such as uncertainty as to hours, delays on the road, and vexatious or rude treatment.

4thly,—The carriages might be neglected and uncomfortable, and the road kept in an imperfect, or even dangerous condition.

5thly,—The interest and accommodation of branch lines might be sacrificed, or at least postponed, to those of the main line.

These evils might not be all present together on any one line ; but it is probable that they would, in a greater or less degree, be felt and experienced in all.

Another, and very important, consideration is, that the power given to railway companies places the service of the mails entirely at their discretion. There is nothing to prevent their securing, in their respective lines, a great part of the revenue of the Post-office ; for the letters must be carried by them, and they might exact what terms they pleased in the existing state of the law.

Competition, the usual corrective of such abuses, can, in these cases, be rarely resorted to ; and although managers and directors of companies, who took an enlightened view of their duty to the public, or even of their own interests, would not suffer them to exist to any great degree, yet we fear that it would not be safe to trust entirely to such motives for protection : and hence it becomes important to consider by what means these evils may be guarded against, without imposing injurious restrictions on private enterprise.

In Ireland, where railway communication must, for a length of time, be restricted to a few main lines, such protection would be indispensable. We shall endeavour, in a subsequent report, to offer some suggestions towards effecting this very desirable object.

In concluding these observations, we humbly beg to assure your Majesty that we shall continue to pursue our inquiry with unremitting diligence. We regret that our researches being only in progress, our materials imperfectly collected, and our opinions on many points not sufficiently matured, it has not been possible for us to do more in this preliminary Report, than indicate the course of investigation which we are following. We are fully sensible that the subject is one which requires to be treated with great caution and deliberation. Aware of the extensive interests at stake, and of the anxiety with which our final Report is looked for by many of the parties engaged in or affected by these speculations, we shall spare no pains to forward our inquiry ; and we venture to express a confident hope that we shall be able to complete our final Report in the month of May. We could have wished that we had been at liberty to devote a much longer period to so important and intricate a subject ; and we are deeply sensible of the many defects and omissions inseparable from the rapidity with which our proceedings have necessarily been conducted. We trust, however,

that, by the time above-mentioned, we shall be able to lay down the lines which shall appear to be best adapted to promote the great objects in question, and to complete the documents which may be necessary to enable those to whom your Majesty may refer the consideration of our Report, to judge of the recommendations which we shall venture to make, as well as of the opinions which, in obedience to your Majesty's command, we shall deem it our duty to express on the various projects now before the public.

We humbly submit this, our first Report, to your Majesty's consideration.

T. DRUMMOND,                      PETER BARLOW,  
J. F. BURGOYNE,                  RICHARD GRIFFITH.

*Dublin, 11th March, 1837.*

HARRY D. JONES, *Secretary.*

## REPORTS ON TUNNELS [A],

WITH NOTES BY THE EDITOR.

[A] [We insert the following reports for the amusement of our readers. They contain the best specimens of twaddle we have yet seen on tunnels.—ED.]

### LEEDS AND SELBY TUNNEL.

*Report of Dr. Davy and Dr. Rothman.*

AFTER careful inquiry, and an examination of this tunnel, we are of opinion that it has no injurious influence on the health of the passengers. We have come to this conclusion from finding:—

1st. That the air in the tunnel at the time of passing is not appreciably vitiated. Chemically examined, its composition appears to be the same as that of the atmosphere, even after repeated transits of the locomotive engines. [B]

2d. That the temperature of the air in the tunnel, though more uniform than that of the external air, does not vary so much from it as might have been anticipated. In the warmest weather in which observations have been made, the air of the middle of the tunnel was only 8° lower than that of the atmosphere, the latter being 70°. In February, the greatest difference we found was also 8°, the atmosphere then being at 56°. [C] We were assured that, during the severest weather of last winter, the temperature of the tunnel never fell to the freezing point.

3d. That the humidity of the air in the tunnel, judging from the few experiments which we have been able to make, will be more uniform than the temperature. That it will generally be somewhat greater than that of the external air, but never suffi-

ciently so to cause the precipitation of aqueous vapour in the carriages, or on the persons of passengers. [D]

4th. That we have not been able to detect, in any part of the tunnel, traces of acid, or other irritating or noxious effluvia. [E]

The tunnel, at present, is passed through in darkness, which, though not dangerous, is to many persons unpleasant. [F] This seems to require correction, and it is understood to be in contemplation to attach lamps to the carriages. [G]

The noise made by the engine and train of carriages did not seem to us much greater in the tunnel than in the open air, nor to form any reasonable ground of complaint. [H] Annexed to this Report is a certificate by Dr. Williamson, a high medical authority in Leeds, generally in accordance with the opinions above expressed. He has even arrived at the conclusion, which we see no reason to doubt, that travelling on the railway is often beneficial to persons in delicate health, particularly in certain cases of slight pulmonary disease. [I]

The tunnel in question is situated very near the terminus of the railway in the town of Leeds. It is 700 yards in length, 17 feet high, and 22 broad. Its direction is nearly east and west. The inclination of the floor is 1 in 300. It has three shafts at irregular distances, which now serve the purpose of ventilation. The westernmost is somewhat the deepest; the depth of this is 23 yards, measured to the floor of the tunnel. The tunnel is bricked throughout its whole extent. It is traversed by 20 engines daily, and on average by 350 passengers. The average time of passing is about a minute and a quarter. The steam is generated by coke of the best quality, under a pressure of 56 lbs. With regard to our sensations in passing through the tunnel, with the windows of the carriage purposely left down, we experienced nothing unpleasant, either from smoke, vapour, or currents of air. The temperature in the carriage was agreeable, and every thing felt dry. [K]

We would conclude by observing, that the opinions [L] we have expressed of this tunnel we hold to be applicable to all other tunnels, the circumstances of which are similar; and to tunnels of greater length, if they are higher and have a sufficient number of shafts to secure an adequate ventilation.

JOHN DAVY, M.D., F.R.S., Assistant Inspector of Army Hospitals.

R. W. ROTHMAN, M.A. & L.M., Fell. Trin. Coll. Camb.  
21st February, 1837.

#### NOTES.

[B] Why, Dr. Reid says, the engines add about 1 per cent. to the atmosphere of carbonic acid gas, a most deadly gas.

[C] Mr. Smith says, the walls of this tunnel are always at an "even temperature," in *Railway Magazine*, No. 12, p. 89. But, supposing it to be as described, does not Dr. Davy know that a

sudden change, of much less than  $8^{\circ}$ , is sufficient to give a severe cold?

[D] What, not when the external air is much colder than that of the tunnel, that is at a time when the re-evaporation would be the most dangerous? Reason and experience are against you, Doctor!

[E] Indeed! Where does what comes out of the engines go to, then?

[F] We believe it.

[G] Which may give a light half a million times less than that of full day-light, a mere trifling transition for delicate eyes!

[H] Smith (Railway Magazine, No. 12, p. 89,) says, from experiment, just the contrary: "Two great inconveniences in tunnels are noise and want of light." Perhaps the Doctor is a little deaf.

[I] We remember to have heard of a doctor who recommended his patients to inhale every morning the odoriferous exhalations of a night-table well stirred up. His patients called him "a nasty fellow." We hope Dr. W. is not a disciple of him.

[K] While the walls were quite damp, as they ever are?

[L] So then they are mere opinions, not facts. We are quite satisfied. We hope the gentlemen's fees were not of the same coin.

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### *Dr. Williamson's Report.*

In reference to the effects of the transit through the tunnel of the Leeds and Selby Railroad on the health of passengers, I have to state that, in the whole of my experience, both in private practice and in my official connexion with the Infirmary, and with the other medical institutions of this town, I have never seen a case in which I could [would?] ascribe injurious results to that circumstance. I have, indeed, frequently recommended delicate persons to make excursions on the railroad for the benefit of their health, and have known very decided advantages to accrue from such excursions to persons even labouring under the slighter forms of pulmonary irritation.

I conceive that the vapour, smoke, and the gaseous results of combustion can never exist in such proportions as materially to deteriorate the air; and that there is no degree of humidity, or deleterious emanation, peculiar to the tunnel, which can be appreciably detrimental to animal life.

I believe that persons of irritable bronchial membrane may respire in the air of the tunnel for a considerable period without feeling the slightest inconvenience or sustaining any injury.

(Signed) JAMES WILLIAMSON,

Senior Physician of Leeds General Infirmary, and Lecturer on the Practice of Physic in the Leeds Medical School.

[This gentleman so deals in generals, that we cannot grapple

with him. It is all BELIEVES and CONCEIVES. We fear he is of the wrong gender, from his *conceiving* so; and in that case our politeness would not allow us to contend.—Ed.]

## PRIMROSE HILL TUNNEL ON THE LONDON AND BIRMINGHAM RAILWAY,

*By John Ayrton Paris, M.D., Cantab., Thomas Watson, M.D., Cantab., William Lawrence, Esq., R. Phillips, Esq., and William Owen Lucas, Esq.*

WE, the undersigned, visited together, on the 20th February, 1837, the tunnel now in progress under Primrose Hill, with the view of ascertaining the probable effect of such tunnels upon the health and feelings of those who may traverse them.

The tunnel is carried through clay, and is lined with brickwork. Its dimensions, as described to us, are as follows: height 22 feet, width 22 feet, length 3,750 feet. It is ventilated by five shafts, from 6 to 8 feet in diameter, their depth being 35 to 55 feet.

The experiment was made under unfavourable circumstances. The western extremity of the tunnel being only partially open, the ventilation is less perfect than it will be when the work is completed. The steam of the locomotive engine also was suffered to escape for twenty minutes, while the carriages were stationary near the end of the tunnel; even during our stay near the unfinished end of the tunnel, where the engine remained stationary, although the cloud caused by the steam was visible near the roof, [M] the air for many feet above our heads remained clear, and apparently unaffected by steam or effluvia of any kind; neither was there any damp or cold perceptible. [N]

We found the atmosphere of the tunnel dry, and of an agreeable temperature, and free from smell; the lamps of the carriages were lighted; and, in our transit inwards and back again to the mouth of the tunnel, the sensation experienced was precisely that of travelling in a coach by night, between the walls of a narrow street. The noise did not prevent easy conversation, nor appear to be much greater in the tunnel than in the open air. [See note H.]

Judging from this experiment, and knowing the ease and certainty with which thorough ventilation may be effected [indeed! how?], we are decidedly of opinion that the dangers incurred in passing through well-constructed tunnels are no greater than those incurred in ordinary travelling upon an open railway or upon a turnpike-road; and that the apprehensions which have been expressed that such tunnels are likely to prove detrimental to the health, or inconvenient to the feelings of those who may go through them, are perfectly futile and groundless. [O]

JOHN AYRTON PARIS, M.D., Cantab.

THOMAS WATSON, M.D., Cantab., Physician to the Middlesex Hospital, and Professor of Medicine at King's College.

WILLIAM LAWRENCE, Surgeon of St. Bartholomew's Hospital.

RD. PHILLIPS, Lecturer on Chemistry at St. Thomas's Hospital.

WM. OWEN LUCAS, Surgeon, Taunton-place, Regent's-park.

*London, 21st February, 1837.*

#### NOTES.

[M] Might not the steam have been apprehensive the gentlemen were about to fib a little, and did not like to descend for fear of contamination?

[N] How could they feel cold, when the air they came out of, the external, must have been several degrees below that of the tunnel at such a season?

[O] Do those gentlemen think their feelings or opinions are to be law, and the standard of other people's? We have heard that a body of men will together do and say what either of them separately would be ashamed of. Is it so here? In opposition to all this we say, that we have never been able to enter a tunnel without most disagreeable sensations arising from our then reflections of being far under ground. These sensations, we have heard, are equally felt by thousands of others, setting aside ladies of delicate nerves. Are such facts to be swept away by the impudent assertion of any five men in England, that they do not exist? Surely these gentlemen are of surpassing modesty! They should be framed and glazed as nonpareils in their way.

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#### REPORT ON THE ATMOSPHERE OF TUNNELS.

*Founded on Chemical Analysis, by Dr. D. B. Reid, F.R.S.,  
M.R.C., Phys. E.*

THE Leeds and Selby Railway Tunnel, in which the experiments have been made, is 700 yards long, 17 feet high, and about 22 wide. It inclines one foot in 300, and is provided with three ventilating shafts, made originally in excavating the tunnel. They are respectively, 23, 22, and 19 yards deep, measuring from the top to the floor of the tunnel.

No fire or machinery is used to promote the ventilation of this tunnel. I have no hesitation, however, in expressing my conviction, that the air it contains is not injurious to the health of passengers, being renewed sufficiently often by the currents which always prevail in it, to preserve a wholesome atmosphere. The

following are the reasons that have induced me to adopt this opinion :—

I. The examination of numerous specimens of air, procured from the tunnel under every variety of circumstances, by an assistant, who made observations there for a week, according to the directions I had given him, has shown me that the amount of carbonic acid communicated to the air by the locomotive engine is considerably less than one per cent. [P]—an amount too trifling to be taken into consideration, as capable of affecting the health of passengers in the railway coaches during their progress through the tunnel.

II. If the average amount of coke consumed in each trip within the tunnel be calculated, and the volume of carbonic acid it produces be compared with the bulk of the air in the tunnel, we arrive at the same conclusion as by the experiments referred to.

III. But the carbonic acid must not be considered as equally diffused throughout the whole of the air in the tunnel. From the circumstances under which it is produced, it is necessarily at an elevated temperature and mixed with a large quantity of moisture; and though its temperature may instantly be reduced on coming in contact with the air, still the specific gravity of the great mass of the air in which it is enveloped is less than that of the rest of the air in the tunnel, and it floats principally above the roofs of the coaches till it escapes. [Q] The heat and moisture more than counterbalance any increased density from the carbonic acid, and numerous researches have shown that very heavy gases do not readily separate from air when they have been intimately mingled with it.—[True, but they intermingle with it rapidly.]

IV. The temperature of the air in the tunnel, during the week that my assistant conducted his examination, &c., did not differ much from that of the external air; the greatest difference observed, did not exceed six degrees. Its temperature is more uniform than that of the external air. On one occasion, the temperature of the air at the top of the deepest shaft rose, in a few seconds, from  $37^{\circ}$  to  $40^{\circ}$ , as the engine passed and the vapour ascended from it, and fell as quickly again to  $37^{\circ}$  as the vapour escaped. [See note C.]

V. No impurity was detected in any of the specimens of air I received, except the carbonic acid, which, as already stated, bears a considerably smaller proportion than one to 100. [R]

I may add, that I have been disposed to take a favourable view of the ventilation\* of tunnels generally, notwithstanding they should be longer than that under consideration; though local peculiarities may at times require special arrangements. [S]

*Roxburgh Place, Edinburgh,*

*13th March, 1837.*

*D. B. REID, M.D., F.R.S.E.*

*Lecturer on Chemistry.*

\* N.B. Dr. Reid has been engaged in the ventilation of the Houses of Parliament.

## NOTES.

[P] Is not the usual quantity one-tenth per cent? Is then 1000 per cent. advance on what nature permits nothing?

[Q] Carbonic acid gas is about 50 per cent. heavier than common air. And all gases in contact intermix rapidly, even when the lighter is above one considerably heavier—so say experiments long since established; but here is the heavier above the lighter, to help the intermixture, and yet it will float at the top without mixing until it escapes! As the countryman exclaimed, so do we, *O Tempora! O Moses!*

[R] We doubt this much, if the specimens were fair ones.

[S] We beg to whisper to the Doctor and to the others, that fees sometimes go a great way towards forming opinions. In France, gold taken internally, has lately been found very serviceable in certain diseases of the body; we now fear in England, if taken in the pocket, it may occasionally produce sad aberrations of the mind. However that may be, these gentlemen, if they are a little touched, are very harmless, and their prattle very amusing; but as to convince, it could never be intended for that, at least where the smallest portion of common sense reigns.

We have a few questions to put to these gentlemen, but must postpone them for the present.

## SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

*Mummy supposed to be of the Body of Memnon.*—In Jersey, a museum has been recently formed, which already contains some valuable treasures. Among others are some Egyptian antiquities which have been brought home by a native of the island of Jersey. There is a mummy most superbly ornamented, on a tablet on the inner coffin is the name of Amunoth the Third, whom Mr. Wilkinson identified with the musical Memnon. Doubts are entertained whether this is the identical body of the monarch, or of some distinguished personage who died during his reign. The grandeur of the coffins would lead to the former inference. It has evidently not seen the light for 3,000 years. Should it be the actual Memnon, it might lead to the discovery of the site of the vocal tomb, unless that might have been a cenotaph.

Another curiosity is presented in some bricks sun-dried, one of which is stamped with the name of Thotmes the Second (the oppressor of the Jews), and another with the name of his successor Thotmes the Third. What is most deserving of notice is, that in the one there is much less straw than in the other, and the little there is, is only spread on the surface; whether this was the result of accident, or the actual production of Israelitish hands, is not clear. The bricks were found, as geologists would say, in



situ, and cannot, therefore, be the brick of an Arab or a Jew. But a not less singular fact is a piece of well-made glass found in one of the Egyptian tombs of a very ancient date, and which had not been previously opened. This, therefore, proves that the manufacture of glass was known much earlier than the period usually fixed for its introduction. Hence it should appear that much interesting information may be obtained from the country termed "the cradle of arts and science."

*Continuous Bearings.*—We have lately seen a pamphlet on this important subject, by Mr. John Reynolds, who obtained a patent for a particular kind of rails described in our fourth number. We know Mr. Reynolds to be a very ingenious and respectable man, who has followed out his subject with great labour and expense; and it is, therefore, with great pleasure we again call attention to his invention.

*Steam Carriages.*—Mr. Alexander Gordon, C.E., we perceive, has published another pamphlet on the "comparative expedition, safety, &c., of railroads and steam-carriages, in which he deals out some hard blows to the advocates for railroads. Our opinion ever has been, that "steam-carriages" will ultimately be brought to run with convenience and economy relative to horse labour on common roads; but whether they will ever be able to rival railroads is a question of difficulty to answer. In convenience they may, because they can go anywhere. In expedition—the excellence of railroads—they never can. In economy we do not know, for we have not the materials by us to enable us to draw the comparison. Our present impression is adverse to them, in consequence of the vastly greater friction, and consequently, wear and tear.

*Slipping down of a Portion of a Mountain in Hudson's Valley.*—On the 5th of January an enormous mass of clay was detached from a hill, called Mount Ida, which overlooks the town of Troy, at the height of 500 feet, and has slid down a distance of 800 feet, covering many acres of land, and carrying away in its course to the distance of 200 feet, three houses and two stables to the edge of a ravine, situated at the corner of Washington and Fourth-street. The clay had a thickness of ten to forty feet. Five great trees were taken from the top of the hill to the bottom, some being left upright, others a little inclined. Torrents of water and sand accompanied the falling mass of clay with a frightful noise. Five persons and six horses were buried under the ruins of houses.

Troy is situated on the east bank of the Hudson, six miles north of Albany, with a population, in 1833 of 11,405.

*Microscope to examine the different Sides of an Object successively, without making it go out of the Field of View.*—MM. Trécourt and G. Oberhauser have presented to the French Academy of Sciences an apparatus which turns with the object, carried in such a manner, as without any derangement, the observer may illumine either side of the object, opaque or diaphanous.

*Lamp Microscope.*—An ingenious artist has lately sent to the Adelaide Gallery a lamp microscope, on the plan of the solar, which, at the expense of about thirty shillings, will enable any one to have a microscope on his own table. It is exceedingly simple and portable, but its utility will depend on the goodness of the lamp used.

*Stone Meal (Farine de Pierre) used in China for Food in the time of Famine.*—In the vast empire of China the most terrible famines sometimes occur. Men of wealth have been suddenly reduced to sell their wives and children, their utensils, furniture, and houses to procure food, and that food, perhaps, nothing more than the rind of a certain tree, or a decomposed stone, found occasionally in the mountains. The Chinese assert that this stone is not an ordinary but a miraculous production. However, there is very little doubt but that it is merely a soft whitish stone pulverised by the united powers of the sun and atmosphere, and if sought for to be found probably at any time. M. Biot has lately taken some pains to inquire into the causes of those direful calamities which drive an industrious and agricultural people to such extremities. China contains immense plains, in a high state of cultivation, with large rivers running through them, the beds of which are obliged to be kept clean, by great labour, from the perpetual deposits. While these rivers are restrained within their due bounds—the artificial banks thrown up for the purpose—they afford the means of fruitful irrigation; but when they once overflow, they spread devastation and destruction to an indescribable extent. Hundreds of thousands, perhaps millions, of acres are involved in one common ruin; and the poor wretches that escape drowning fly to the mountains to perish by thousands for want of food. It is in this awful destitution they seek out these stones, and not having, probably, in happier times taken the trouble to look for them, now attribute their appearance to miracles.

*White Natives in Africa.*—Two or three travellers have asserted that in the Atlas mountains, which extend across part of Africa, women with the most lovely white complexions, having generally white hair and blue eyes, have been found. An instance of this sort has lately been mentioned in the Royal Academy of Sciences, by M. Guyon. The woman was married and had three children, all resembling herself.

*Avery's Steam Engine.*—This instrument, which is making much noise in America, and has lately been dancing a minuet through the papers, is a re-invention of Hiero's toy of Alexandria, 120 years before Christ. It is on the principle of Barker's water-mill, which is a pretty little play-thing for the nursery. We cannot see how this machine can ever be a powerful one. It consists, as our readers probably know, of a hollow tube as an axle, through which the steam passes to two hollow arms, revolving in a plane at right

angles to the axle. The steam in the arms will evidently have the same pressure as in the boiler, if there is no aperture in them for its escape; and they will remain at rest. But if towards the end of each there be a hole drilled looking opposite ways, but in the plane of their revolution, the steam will rush out. And since the internal pressure on the arm is less on the side where the hole is, than on the other, by a force corresponding to the area of the hole, the arm will be driven backwards from the out-rushing steam by a force nearly equal to such defect of pressure. Avery has constructed arms of eighteen inches long, with an aperture in each the one-sixteenth of a square inch. This is a mere whistle; we must have arms of, perhaps, two feet each, and not less, and an aperture of fourteen square inches to each, to do the work of a locomotive of ten tons with steam at 50lbs. pressure. We think our readers will see some very serious difficulties in this which another time we may discuss.

In the mean time we may observe that a model and plan of a new engine was submitted to us a few months since, which promises to be one of the simplest and most efficient we have yet seen. Twice we had given a general opinion against this engine, and as often we were politely told by the inventor we were wrong. At length we went into it mathematically; and our report gave results exactly agreeing with his previously stated experiments and against our previous opinions. If the inventor follows this out we think the public will have an engine combining power with simplicity and economy, in a very eminent degree.

*Van Mons' Method of raising Fruit-trees from the Seed.*—(Continued from p. 175.)—As soon as the young pear-tree with which he began his experiments produced its first fruit, Mr. Van Mons sowed the seeds. There resulted a first generation, the individuals of which, although of very different kinds, did not resemble their parent. He cultivated them with care, and endeavoured to hasten their growth, as much as possible, by all the known means in his power. These young trees yielded fruit, which were generally small, and almost all of them bad. He sowed the seed of these, and obtained a second generation without interruption—which is very important—that were very different in kind, but did not resemble their parent, although they had a less wild appearance than their predecessors. These were cultivated with equal attention, and they fructified earlier than had their parent. The fruits of this second generation also varied as much as the trees which bore them, but part of them appeared less near the wild state than the preceding; yet only a few possessed the requisite qualities to intitle them to preservation. Constant in his plan, Mr. Van Mons sowed the seeds, and obtained a third continued generation, the greater part of the young trees of which had a *phasis* of good augury, that is, something of the physiognomy of our good domesticated pear-trees, and they were

consequently less various in appearance. Being carefully cultivated, as had been the preceding, these trees of the third generation fructified still earlier than had those of the second generation.

Several of them produced edible fruit, although not yet decidedly good, but sufficiently ameliorated to convince Mr. Van Mons that he had discovered the true path to amelioration, and that he should continue to follow it. He also recognised with not less satisfaction that the oftener the generations succeeded each other, without interruption, the more promptly did they fructify. The seeds of the fruit of this third generation, which had a good appearance, were sowed, and the trees managed as carefully as the preceding, and produced a fourth generation, the trees of which were a little less varied, and nearly all of them had an appearance of favourable augury; they fructified in a shorter time than the third generation: many of the fruits were good, several excellent, but a small number still bad. He again took the seeds of the best kinds of those pears, sowed them, and obtained a fifth generation, the trees of which were less various than the preceding, fructified sooner, and produced more good and excellent fruits than those of the fourth.

He continued his experiments till 1834, when he had reached the eighth generation, and at each he always obtained fruit more and more perfect.

Mr. Van Mons made the same experiment on almost all the other kinds of fruits. The apple yielded no other than good fruit in the fourth generation. The stone fruits, as the peach, apricot, plum, and cherry, became perfect in a still shorter time, all of them produced good and excellent fruits in the third generation; which should be the case, for our stone fruits always reproduce more or less good without any particular attention, and, therefore, they should with less difficulty, and in shorter time, arrive at a perfect state of amelioration.

The *time* required to arrive at a satisfactory result, that is, the number of years before each tree would produce its first fruit, and the number of generations necessary to advance the fruit to a state of sufficient excellence, was a subject of anxious importance. Van Mons found that three or four generations in uninterrupted succession, embracing from twelve to fifteen consecutive years, were sufficient to obtain no other than excellent fruit from the stones of peaches, apricots, plums, and cherries; and to obtain none other than excellent apples, four successive generations, and about twenty consecutive years were required. With the pear, the difficulty was greater. At first, Mr. Van Mons was unable to procure the seeds of varieties very recently procured: the seeds he was obliged to commence his experiments with, were obtained from ancient varieties, whose age was much advanced, which from experience tended to retard the first fructification of his young trees. Nevertheless, Mr. Van Mons has been able to ascertain

that twelve or fifteen years was the mean term of time from the moment of planting the first seed of an ancient variety of the domestic pear, to the first fructification of the trees which sprung from them. The trees from the second sowing of the seed of the first generation, have yielded their first fruit at an age of from ten to twelve years, as the mean term; those of the third generation at an age of from eight to ten years; those of the fourth generation, at an age of from six to eight years; and finally, those of the fifth generation, at the age of six years. Mr. Van Mons being actually at the eighth generation, has informed me that he has obtained several pear-trees which fructified at *the age of four years*.

From this decreasing progression, it may be seen that the fear of a lengthened experiment ought to decrease in proportion as it advances; and that, adding the requisite years of the first five generations of the pear, a point is reached where none other than excellent pears are obtained, at the end of forty-two years. But if in each generation, as has been shown, there are always several trees which do not await the mean term named for their fructification, the time may be estimated at thirty-six years, for obtaining from the pear, in five uninterrupted generations, new trees and fruits, all of which are of excellent quality. The time can still be more abridged, for in one of his last letters, Mr. Van Mons informed me that from two of his first sowings of pears, there were trees produced which fructified at the age of six years.

His method of treating his seedlings was as follows:—

He left them in the seed-bed two years; he then took them up, threw away a part as worthless, and transplanted the most vigorous at a proper distance to allow them to develop themselves. He planted them sufficiently near to force them to run up tall, and to form pyramidal tops without pruning; this hastens, he states, their fructification. This distance was about ten feet. While waiting for them to fructify, opportunity was afforded to examine the characteristics of their future excellence. It was generally not until they were four years of age that they began to develop distinctly these characteristics. From long-continued observation, he was enabled to establish the following prognostics.

“1. *Prognostics of favourable Augury*. A good form, a smooth and slightly shining bark, a regular distribution of the branches, in proportion to the height of the tree; annual shoots bent, striated, a little twisted, and *breaking clean without splinters*, thorns long, garnished with eyes or buds, their whole, or nearly whole length; eyes or buds plump, not divergent, red or grizzled leaves, smooth, of a mean size, crimped on the side of the middle nerve, *bonne* petioles rather long than short, the youngest in spring remaining a long time directly against the bud, the others, or the inferior, expanded, hollowed into a gutter from the bottom towards the top, but not their whole length.

“2. *Prognostics of bad Augury*. Branches and twigs confused,

protruding like those of the hornbeam, or broom, thorns short, without eyes, leaves averted from the bud from their first appearing, small, round, terminating in a short point, guttered their whole length."

These characteristics indicate small fruit, fresh, sweet, and dry, or baking fruit and late.

"3. *Prognostics of early Fruit.* Wood large, short, buds large and near.

"4. *Prognostics of late Fruit.* Wood slim, branches well distributed, pendent, the shoots a little knotted generally denote late delicious fruit, with leaves round, point short, stiff, of a deep green, borne on petioles of mean length, are analogous signs, but less sure."

(To be Continued.)

REVIEW OF BOOKS.

*Panoramic View of the Westminster Bridge, Deptford and Greenwich Railway, and of part of the Metropolis, from the Duke of York's Column.* By John de Paine, Architect to the Company. —The style and spirit of execution of this view, do Mr. Paine great credit. From the peculiar situation of the site chosen, it makes a very interesting and beautiful picture. If there is any fault, it is that of not being sufficiently near to the proposed line of Railway to give us that detailed view of it, one seems to desire of so interesting an object.

Mr. Paine has likewise published a view of the interior of the Arcade beneath the Viaduct, on which it is proposed to carry the Railway. In this design is an example of that taste and elegance which we hope to see more attended to in these great national undertakings than hitherto they have been.

*A Tabular Chronological Epitome of the History of Architecture in England.* By George Godwin, Jun., Architect. Weale, 59, High Holborn.—Within the brief limits of a Quarto card Mr. Godwin has contrived to compress a vast deal of useful information respecting the dates, durations, and characteristics of the principal styles of architecture, which have prevailed from the invasion of the Romans to the "*Revival*," in Charles the First.

*An Appeal to the Public, on the subject of Railways.* By George Godwin, Jun., Associate of the Institute of British Architects. 8vo. 1837.—At a moment when the gambling speculators in railway shares, are not only cooled, but almost frozen, the tradesman, the manufacturer, the agriculturist, the landed proprietors, and indeed all classes of society, may prudently and profitably direct their attention, and apply portions of their capital to the subject.

England in its present state of wealth, enterprise, and commerce, must have its railways: quickness of transit must be adopted; for almost every species of manufacture is now produced by steam-power at a very low price, and in immense quantities.

Consumption is consequently increased, population advances, steam-vessels on the ocean and rivers have multiplied, and internal intercommunication must be improved in rapidity and cheapness, to keep pace with these and other improvements. Every new light that can be obtained to illuminate and explain the subject, is entitled to the candid attention of the political economist, and the pamphlet before us is among the number. Mr. Godwin has reviewed the question in the spirit of a philosopher and historian; he views it as a national measure, and shows plainly and incontrovertibly that as turnpike roads and canals have produced many and important benefits to society, the new system of railway communication must tend still further to promote civilization and refinement—facilitate the diffusion of knowledge—benefit the tradesman, the manufacturer, and the agriculturist, and administer to the wants and luxuries of the whole community. The pamphlet has come to us at the last hour, and we have only time to glance over its pages in a cursory way: but it is our intention to resume it at the first opportunity. Every person directly connected with railways will be animated by a perusal of these pages, and those who are not, will have their curiosity exerted and patriotism warmed by attending to their facts and reasonings.

*“Observations on Railways, with reference to Utility, Profit, and the obvious Necessity of a National System. By Richard Z. Mudge, Lieut.-Col. in the Corps of Royal Engineers.”* James Gardner, 165, Regent-street.—Colonel Mudge has here undertaken to recommend a very grave and great object, the formation of a national system of English railroads, on the principle of the Irish Commission. The subject is so momentous that we actually fear to give an opinion at present upon it, we are desirous first to see a little more of the practical working of the Commission for Ireland. Besides this, there are several other points handled with considerable skill and force by the Colonel, on which we intended to make some observations had not want of room prevented us. A neat map of all the lines granted and proposed is prefixed to this little volume.

*LAXTON'S BUILDER'S Price Book, 1837; containing upwards of 8,000 Prices, and 2,000 useful and important Memoranda.”* Eleventh Edition. Weale, 59, High Holborn.—This is an exceedingly useful book, whether it be to the builder, engineer, or gentleman. It is a plain, practical treatise containing an immense quantity of well-arranged and useful information. Eleven editions are a proof of public estimation very few authors can boast of.

*Wishaw's Analysis of Railroads for 1837.* Weale, 59, High Holborn.—To those who wish to know the peculiarities and

principal features of the several lines projected for the present session, we can safely recommend this book as a very useful one.

Mr. Wylde's map of the seat of war in the north of Spain, especially of the country between St. Sebastian and the French frontier, will be very useful to all who wish to understand the nature of the movements in that quarter.—*Times*.

## RAILWAY NOTICES.

*Birmingham Railway.*—Our having adverted in our last to the affairs of this company with a little more sharpness than agrees with our usual mildness and good humour, (we are not egotists,) has occasioned an inquiry or two whether we are not prejudiced against the concern. We declare we are not; it is on public grounds only we have noticed the affairs; we are not aware that we know one of the parties concerned; and we should be more pleased to speak well than ill of this company, when satisfied it is deserved. We may say the same of the Eastern Counties. But here we do know several of the Directors, some rather intimately, whom we warmly esteem for their high honour and principles. There seems, however, to be a baneful influence at the Board which smothers the good intentions of these gentlemen, and produces results we cordially despise. A radical reformation is wanted, and if not soon had, we would not give much for the concern.

*Petitioning Society.*—A set of fellows, petty Titus Oates, doubtless allured by the hopes of being fed, and well paid out of the public purse, have formed a society for the purpose of petitioning against railway companies.

*Birmingham, Bristol, and Thames Junction Railway.*—The Bill for the extension of this line to Knightsbridge has been lost upon a point in that unintelligible mass of confusion, the Standing Orders. We regret it, because, in our opinion, it would have tripled the value of the line.

*Brighton Railways.*—These lines are all in Committee except Mr. Mills's, and fighting their battles over again to the entire satisfaction of the lawyers and professional witnesses. Stevenson's and Sir John Rennie's lines have closed their engineering cases, and the others will be brought on after the recess. Much surprize has been expressed that Sir John Rennie has not been called. No person can at present conjecture which line is likely to succeed. Some think they will all again be "turned round."

It has been generally considered that Mills's line has been treated very harshly. Every one knows the standing orders are so imperfect that probably there are hardly two men who read them alike. On one of these sage rules Mills's line has been thrown out, through the rival line of the Stevensons, and on a point on which the Committee



were so equally balanced that it fell to the chairman to give the casting vote. This was a nice balance, therefore and considering that the party complaining was a rival line we do think Mills's ought to have been allowed to go into Committee, and rest in a fair comparison with the rest on its own merits.

A junction has been formed between Messrs. Stevenson and Gibbs's friends. We wish all would do the same and save the extravagant expenditure now going on. If the lines were submitted to some competent persons there would be little difficulty in settling the question of merit and utility. We believe the united expense has been very little if anything short of £1,000 per day.

*Croydon Railway.*—This company has issued a report which has been very satisfactory to its shareholders.

*Communication between England and Ireland by Railway.*—At a numerous and highly respectable meeting, at which were the Marquis of Clanricard, Colonel Parry, M. P., Colonel Owen, M. P., —Roche, Esq., M. P., Hon. Frederick Mullins, M. P., O'Conner Don, M. P., &c., resolutions were passed, declaring that a railroad, through South Wales to Fishguard Harbour was most desirable, but the meeting refused to pledge itself to any particular line, but to choose the best.—*West Kent Guardian*.

*Doncaster, North Midland, and Goole Railway.*—In consequence of the recommendation of the North Midland Railway Directors, it has been deemed advisable to defer the application to Parliament for the railway until next session.—*Yorkshireman*.

*Eastern Counties Railway.*—We understand the Board of Directors (we beg pardon, we mean Mr. Robertson), intends to put in such an answer to Lord Petre's allegations, as shall astound the very walls of Chancery. We shall see. Of this he may rest assured, that "shuffling" and little low cunning will not succeed in that Court. Can he get rid of the attempt to outwit or overreach Lord Petre, which it appears to us, his published correspondence plainly proves, and which hangs like a deep cloud over the honour and conduct of the Directors? Can he get rid of the falsehood charged on the statements in his letters by Lord Petre and Messrs. Few and Hamilton? Can he deny the bond to Lord Petre solemnly entered into, and out of which it is now attempted to wriggle? Can he get rid of the 120,000*l.*, which, on every principle of honour and honesty, is bound to be paid? Will the shareholders pay it? we think not. Will the Directors? we hope not. But, perhaps, Mr. Robertson will take it on himself, and pay it off with *eclat*? Doubtless, he would not do it like poor Tom,

"Who quite reduced to his last shilling,  
Says to his creditors, I am wi ling  
Your clamours all to hush:  
They chuckling thought to grasp his chink;  
Tom kept his word, but how d'ye think?  
He gave them all the brush."

We hear it is attempted to throw on Lord Petre the odium of having imposed on the Board, by declaring there was a better line in a certain direction. What stuff! Had they not an engineer, who in one day could have settled that question by levelling the whole seven miles, or twice the length if needed? Had not Mr. Robertson better own it was all an innocent attempt to cheat Lord Petre?

We give the following anecdote as too good to be lost. "Have you begun your works?" said a gentleman to Mr. Robertson the other day. "No; but we have splendid offices; come and see them!" How gratifying this must be to the shareholders, after paying about 60,000*l.* in deposits and 40,000*l.* of the first call, to see that they have splendid offices, with increased expenses, and nothing done towards the main object? We have ourselves a few questions to ask about Mr. R.'s salary, his other avocations, some monetary affairs, past times, &c., &c.; but we cannot occupy more of the Magazine now.

*Grand Junction Railway.*—We are informed on good authority, that the road is now very nearly completed and will be opened for passengers from end to end in June next. Part of the engines, carriages, &c., are now ready for immediate use, and the rest will be delivered during the next two months. Only 85*l.* has yet been called out of every 100*l.* share, and the Directors are now borrowing money, their purpose, as we learn, being to finish the works of the railway without calling for the whole of the remaining 15*l.*—*Gore's General Advertiser.*

*Greenwich Railway.*—We have now before us the daily receipts of the above line, from Feb. 26th to March 27th, which amount to 4,088*l.* 9*s.* (and this a short month) or 49,061*l.* per annum. The receipts for Good-Friday, Easter-Day, Easter-Monday, and Easter-Tuesday, were

	Persons.		£.	s.	d.	£.	s.	d.
Friday	12,447	- - -				342	5	6
Sunday	10,643	- - -	307	11	9			
		Footpath	21	4	9			
						328	16	0
Monday	24,125	- - -	622	10	0			
		Footpath	22	10	1			
						645	0	1
Tuesday	15,587	- - -	405	8	3			
		Footpath	12	11	4			
						417	19	7
Total	62,802					Total	£1734	1 2

The total persons carried throughout the month were 149,729, bad as the weather was. What will our anti-railway gentlemen say to this?

*Kent Railway.*—The Select Committee to inquire into the alle-

gations of the petitions alluded to in our last respecting this Company, commenced on the 6th and closed on the 18th. But as the report will not be made until the first day after the recess, we must say nothing of the evidence. Mr. Parkes, Solicitor and Parliamentary Agent, managed the case for the Crown, Messrs. Thesiger and Hill for the defence. We regret the delay, because it keeps many parties in torturing suspense. Time for first reading extended to April 17th.

*London and Birmingham Railway.*—The Watford tunnel on this railway is now completed. It is one mile and seventy yards in length, twenty-five feet high, and twenty-four in width. The greatest portion of it is through sand and gravel mixed; which render the work difficult and dangerous. The embankment along the Coln valley, Watford, seventy feet in height, is also finished.

*Manchester South Union Railway.*—Several of the principal towns in the eastern counties are manifesting great interest in the success of this railway.

*Newcastle and Carlisle Railway.*—The Directors have opened an additional portion of the line from Blaydon to Redhugh, three and a half miles in length, which gives a railway communication to within three quarters of a mile of the bridge over the Tyne to Newcastle. Another portion from the London-road station, at Carlisle, to the canal basin, is to be opened shortly. This latter makes the western portion from Greenhead complete, and forms a direct communication with the shipping and steam-boats from the Carlisle Canal to Liverpool, and the other ports on the west coasts and with Ireland.—*Tyne Mercury.*

*Railway from Vienna to Milan.*—The railroad from Vienna to Milan is approved by the Emperor, and all the shares are disposed of. It will commence on the island on which the Custom-house is built, and be carried over arches to the main land. It is calculated that the journey, from Vienna to Milan, will be performed in six hours.—*Constitutional*, March 24.

*Railway between Paris and Brussels.*—The French Government are willing to advance a million sterling towards the formation of a railway between Paris and the capital of Belgium, but the basis upon which the advance is to be made is not at present settled.

*Renewal of Application to Parliament.*—A very general opinion prevails that any Bill thrown out in the present session will be lost for at least two years. This a mistake. By the new standing orders §8 (see last vol. p. 455) the plans, &c., may be re-deposited on or before the 30th of Nov. with the clerks of the peace, and if the proper notices be given, and advertisements made in the months of September, October, and November, as in the last year, the application to Parliament may be renewed the next session. The same holds good for every succeeding session.

*Railway Mania in Germany.*—Very lately in Frankfort, books were opened for shares in a railway, to run from that city to

Wisbaden, through Cassel and Biberich, where the crowd of parties wishing to become shareholders was so great that the offices of the bankers were obliged to be guarded by *gendarmes*.

*Southampton*.—"The new bridge over the Itchen is going on most promisingly, and the sea wall, which is to enclose the docks, will be commenced in a few weeks. The contracts for stone, the greater part of which is from the upper fresh water formation of the Isle of Wight; and the edges of the docks of sienitic granite, from Guernsey, are already settled."—*Extract from a Private Letter*, March 6.

*South-Eastern Railway*.—Since our last Number active operations have commenced. The works were begun on the 11th ult. at Riddlesdown, near Croydon, on a portion of the line which is common to Dover and Brighton; and we are informed that satisfactory arrangements have been made which will render some of the proposed deviations unnecessary. The amended Bill for the remaining deviations, including the extension of the line nearer towards London, has passed through the Committee of the House of Commons, and has been reported; and a contract has been entered into by parties, who for many years have been engaged in extensive works through chalk, for the execution of a double tunnel through the Shakespeare Cliff, on the line between Folkestone and Dover, on the plan of Mr. Booth, described in our 12th Number. We have likewise been informed that the contract has been made within the original estimate by one who would undertake to complete it in twelve months, if needful.

*Sheffield and Manchester Railway*.—This line, which is expected to be one of the best paying in the kingdom, has very easily passed the Commons, and is anticipated to be scarcely a day in the Lords. This is as it should be for such important lines. We believe the engineer, Mr. Vignoles, is generally very successful in carrying his lines through Parliament with little opposition. Was it not owing almost to him alone the Eastern Counties Bill so rapidly passed the Legislature?

*Westminster Bridge, Deptford and Greenwich, Bath and Weymouth, and Southwark and Hammersmith (City and Richmond) Railways*.—Petitions, similar to that against the Kent, have been presented against these lines. The investigations were referred to the same Committee, but the petition against the last line has been withdrawn.

*York and North Midland Railway*.—All the proprietors, with the exception of two, on the three and a half miles of this railway, commencing near this city, and extending to the township of Copmanthorpe, have agreed with the Directors. It is therefore hoped that no further delay will be experienced, and that the work will immediately proceed, when the contracts are entered into, in the early part of next month.—*York Courant*.

# PARLIAMENTARY PROCEEDINGS.

One hundred and eighteen notices have been given; 101 plans, &c., deposited; 77 petitions presented; and up to the recess 60 Bills read a first time; 44 a second time; 12 reported; and 4 a third time; 2 have been thrown out in the standing orders; and 2 in the second reading in the Commons, namely, the Portsmouth Junction; and the South Western (Kingsworthy, &c.). The following are the stages advanced since our last :—

Ardrossan and Johnstone, first time, March 20.—Bath and Weymouth, first time, March 15.—Belfast and Holywood, first time, March 20.—Birkenhead and Chester, first time, March 8; a second time, March 17.—Birmingham and Gloucester, first time, February 27; a second time, March 7; reported, March 20.—Bolton and Preston, first time, March 10; a second time, March 21.—Cheltenham, Oxford, &c. (Charlton Kings), second time, March 2.—Chester and Birkenhead, second time, February 28.—Chester and Crewe, second time, March 1.—Clarence (Durham), second time, March 1.—Clarence and Hartlepool (Great North of England), first time, March 20.—Cork and Passage, first time, March 9.—Devizes and Melksham, first time, March 20.—Dublin and Drogheda, first time, March 20.—Dublin and Kilkenny, first time, March 6; a second time, March 14.—Dundalk Western, first time, March 6; a second time, March 14.—Durham Junction, first time, March 20.—Durham and Sunderland, first time, March 9; a second time, March 17.—Edinburgh and Glasgow, first time, March 1; a second time, March 9.—Exeter and Falmouth, first time, March 21.—Glasgow, Paisley, and Greenock, first time, February 27; a second time, March 20.—Glasgow, Paisley and Ayr, first time, February 27; a second time, March 7.—Grand Connexion (Worcester and Wolverhampton), second time, February 28.—Great North of England (Castle Eden, &c.), first time, February 28; a second time, March 8.—Great Western (Paddington), reported March 6; a third time, March 22.—Great Western Trowbridge, reported March 6; read third time, March 22.—Kilmarnock and Troon, first time, March 15; a second time, March 23.—Lancaster and Preston, reported March 20.—Leicester and Swannington, first time, March 2; a second time, March 15.—Liverpool and Manchester, reported March 8; a third time, March 22.—London and Birmingham, first time, March 15; a second time, March 23.—London and Brighton Gibbs's, second time, March 8.—London and Greenwich, first time, March 6; a second time, March 14.—London and Southampton, first time, February 27; a second time, March 7; reported March 23.—Manchester and Leeds, reported March 20.—Manchester, Bolton, and Bury, first time, March 13.—Manchester, Cheshire, and Staffordshire, second time, March 6.—Maryport and Carlisle,

first time, March 15; a second time, March 23.—Oxford and Great Western, reported March 22.—Pollock and Govan, first time, March 20.—Portsmouth Junction, first time, February 27. Preston and Wyre, first time, February 28; a second time, March 8; reported, March 20.—Sheffield and Manchester, second time, March 3; reported March 20.—Slamannan, first time, March 17.—South Eastern, Ashford and Canterbury, first time, March 13.—South Eastern (London and Dover), second time, March 1.—South Midland Counties (Courtenhall), first time, March 14.—South Western (Kingsworthy, &c), first time, March 6.—Taff Vale (Merthyr Tydvil), reported March 20.—Westminster Bridge and Greenwich, first time, February 27; a second time, March 7.—Whithy and Pickering, reported March 8; third time, March 22.—Wishaw and Coltness, first time, March 3; a second time, March 14.—York and North Midland, second time, March 2.

*February 27.*—Mr. Pease implored the House not to pass any bill for railways, unless they were confined to some fixed breadth between the rails. The next day he moved for a Select Committee to that end. Sir H. Verney moved as an amendment, the appointment of a Royal Commission for railways and canals. Both the motion and amendment were lost. With respect to Mr. Pease's motion the House never committed a more lamentable error than it did in rejecting it; and when it is much too late it will be found out. These undertakings are entered into for private gain, no doubt, but the public convenience ought surely to be consulted too. The having of different gages will be nearly as inconvenient to the traveller, as if his journey was broke down into as many different modes of transit.

*March 22.*—Mr. D. W. Harvey again urged his favourite motion of preventing fraudulent subscription deeds to railways, namely, to permit no Bill to enter the House unless 10 per cent. of the total subscription had been actually paid up. This would be an excellent plan if Honourable Members were to be bribed for their influence, by the presentation of so many shares, because they would be worth so much more; but for the progress of improvement nothing could be more unwise. Does the Hon. Member want to be informed that though numberless individuals might be able to pay up 25*l.* or 50*l.* shares, by easy instalments through a period of seven or eight years, few perhaps could pay down 10 per cent. at once? Neither would they like to venture so much money with the chance of having the Bill thrown out too. If the Hon. Member's plan was adopted it would be a most effectual means of extinguishing railway improvement.

*March 23.*—A petition was presented against the City and Richmond Railway, for a change of its title to that of the Hammersmith and Southwark, after it had passed the standing orders. It is to be gone into after the recess.

# PRICES OF RAILWAY SHARES.

Those finished are marked (1) : in progress (2) : which have their Bills, but are not begun (3) : others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on											
					Feb.		March.									
					28.	3.	7.	10.	14.	17.	21.	23.	28.			
9,500	.....	(3) Birmingham and Derby .....	£.	£.	.....	7	7	8	7	.....	7	6 $\frac{3}{4}$	6			
7,500	.....	(3) Birmingham and Gloucester .....	.....	10	.....	.....	.....	.....	.....	.....	4 $\frac{1}{2}$	.....	.....			
	.....	(2) Birmingham, Bristol, and Thames Junction .....	20	2	.....	.....	.....	.....	.....	.....	.....	.....	.....			
15,000	.....	(3) Bristol and Exeter .....	100	5	.....	.....	1	1	1 $\frac{1}{2}$	.....	.....	1 $\frac{1}{2}$	.....			
660	.....	Calcutta and Saugur .....	50	2	.....	.....	$\frac{1}{2}$	.....	.....	.....	.....	.....	.....			
350	.....	Cheltenham .....	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....			
7,500	.....	(3) Cheltenham and Great Western .....	100	7 $\frac{1}{2}$	.....	.....	.....	.....	.....	.....	.....	.....	.....			
14,000	.....	(4) Cheltenham, Oxford, and Tring .....	100	5	.....	.....	.....	1	.....	.....	.....	.....	.....			
2,000	.....	(2) Clarence .....	100	100	.....	.....	.....	.....	48	.....	.....	.....	40			
12,000	.....	(3) Commercial Blackwall .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....			
8,000	.....	(4) Dublin and Kilkenny .....	100	2 $\frac{1}{2}$	1 $\frac{3}{4}$	1 $\frac{3}{8}$	.....	.....	.....	.....	.....	1 $\frac{1}{2}$	.....			
7,500	.....	(4) Durham South-West Junction .....	20	3	.....	.....	.....	.....	.....	.....	.....	.....	.....			
60,000	.....	(3) Durham Junction .....	100	10	.....	.....	.....	.....	.....	.....	.....	.....	.....			
	.....	(3) Eastern Counties .....	25	2	1 $\frac{1}{4}$	1	1 $\frac{3}{4}$	$\frac{7}{8}$	$\frac{7}{8}$	.....	.....	.....	3 $\frac{3}{8}$			
5,000	.....	Edinburgh and Dunbar .....	.....	2	1 $\frac{1}{4}$	.....	.....	.....	.....	.....	.....	.....	.....			
13,000	.....	(3) Edinburgh, Leith, and Newhaven .....	20	3	.....	.....	.....	.....	.....	.....	.....	.....	.....			
800	.....	(4) Edinburgh and Glasgow .....	50	2	4	.....	.....	2 $\frac{1}{2}$	.....	.....	.....	.....	.....			

[illegible]



# PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on											
					Feb.		March.									
					28.	3.	7.	10.	14.	17.	21.	23.	28.			
15,000	.....	(3) Midland Counties .....	50	5	$\frac{1}{2}$	$11\frac{1}{2}$		$12\frac{1}{2}$	$11\frac{1}{2}$	.....	11	$10\frac{1}{2}$	10			
2,500	.....	(3) North Midland .....	100	10	.....											
2,600	.....	(3) Northern and Eastern .....	100	6												
4,000	.....	(2) Preston and Wigan .....	.....	20												
1,000	.....	(2) Preston and Wyre .....	50	28												
1,500	.....	(3) Sheffield and Rotherham .....	25	6												
1,000	6d. per c.	(1) Stockton and Darlington .....	100	100												
1,500	.....	(2) Stanhope and Tyne .....	100	21 $\frac{1}{2}$												
3,000	.....	(4) South Durham .....	50	7	5	$5\frac{1}{8}$	$4\frac{7}{8}$	.....	.....	$4\frac{1}{2}$	.....	.....	4			
28,000	.....	(3) South-Eastern and Dover .....	.....	2	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	.....	$1\frac{3}{4}$	$1\frac{1}{4}$	.....	.....	1			
24,000	.....	(4) Do. Brighton, Lewes, and Newhaven .....	50	1												
	.....	(4) South Midland .....	50	1			$\frac{1}{8}$	.....	.....	$\frac{1}{4}$	$\frac{1}{4}$					
40,000	.....	(4) South-Western (Stevenson's) .....	50	21 $\frac{1}{2}$	.....											
9,000	.....	(3) Thames Haven .....	50	1												
6,600	.....	(4) Victoria .....	25	2	$1\frac{3}{8}$	$1\frac{3}{8}$	.....	.....	.....	$\frac{1}{2}$	$\frac{1}{2}$					
1,400	.....	(4) Westminster and Greenwich .....	50	2												
6,000	.....	(3) York and North Midland .....	50	3												

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of  $\frac{1}{4}$  in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

# THE RAILWAY MAGAZINE;

AND

*Annals of Science.*

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No. XV.

MAY, 1837.

NEW SERIES.

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*On the Fuel of Steam-engines.* By M. CORDIER. *Translated from the French, as read before the Royal Academy of Sciences.*

“WITH some exceptions, steam-engines are every where heated with coal. This combustible is used generally as delivered by the trade, in pieces of a middling size, mixed with small fragments, and cast into the fire-places with a shovel, commonly about every ten minutes. This method has numberless inconveniences, of which these are the principal—the frequent cooling of the furnace, the inequality of the fire, and of the production of the vapour; the liberation, every time after fresh coal is thrown on the fire, of an immense quantity of smoke, often inconvenient and prejudicial to all the surrounding neighbourhood; the loss of some combustible matter thus liberated, the necessity of a repeated stirring of the fire (tisage), and of a perpetual attendance on the part of the labourer often dearly paid; finally, a rapid alteration of the boilers and their tubes, as well by oxidation as by the sudden variations of dilatation, experienced by the metal, from the rushing in of cold air, while fresh coal is putting on and the fire stirred.

“An idea for remedying these inconveniences is not new. Long since, in England, it has been proposed to employ mechanical distributors, to introduce the coal into the fire-places of steam-engines, and parties are now busy to perfect the apparatus; but whatever use has been made of them in England, every effort to introduce them into France has hitherto been unsuccessful.

“Nevertheless, about twenty years since, when apparatus of this sort was in a very rude state, one of them was fixed in the baths at the quay of Gèvres, which very probably is the only one of the sort hitherto imported. It has continued

to this time working usefully, and its advantages are incontestably sufficient to provoke imitation. It consists principally of a hopper, which, filled with coal, and placed above the fire, is opened at the bottom every half-minute, in order to permit a quantity of the coal, always equal, on the grate, which is circular, and turns round with a slow and continual motion, once in about three or four minutes. From this description it is easy to conceive the operation of the mechanism, and to perceive that it is far from resolving the problem completely.

"In 1822 the matter was found to be singularly advanced in England. For the alternate delivery (*débit*) of the coal in its rough state there was substituted a hopper, having a continued distribution, by means of a grinding apparatus. The revolving grate gave place also to a fixed one, on which the coal, roughly pulverised, was cast by vertical ventilator.

"About the end of this same year, a very distinguished mechanician, M. Collier, whose recent loss the industrious part of France much deplores, took out a patent for importing the mechanical distributor so modified, but he soon discovered, in practice, that the apparatus left much to desire, and from thence he gave himself up to experiments for improving it. Three patents for improvements, during 1823, attest the progress and the success of his researches. By means of some new dispositions, invented by M. Collier, the distributor is definitively become such as one could wish it. I will lay the plans before the Academy, and presently give a summary description of the improvements.

"In this state of things one might have expected that the use of this contrivance would have spread over France; but no such thing. Every effort of M. Collier, where he has applied his invention, has failed, remarkable enough, owing to the bad feeling and silent coalition of the firemen (*chauffeurs*), who clearly perceive that if this machine succeeds their interests will be greatly compromised. Fatigued with this struggle, M. Collier abandoned the undertaking, and that with more reason, because he had need of all his activity to propagate the use of many other machines, entirely of his invention, and much more important. Such as that which bears the name of *Tondeuse*, and that one much more remarkable, perhaps, and less known, for carding wool on a large scale (*à peigner les laines en grand*).

"But, nevertheless, the new distributor remains unknown to us, its utility has been appreciated in England, and its

employment has gained such a footing that it will come back to us as a foreign invention altogether new, under which title it may be favourably received.

"Two have very lately been introduced, and one of them has commenced working in the splendid silk-yarn manufactory (*la belle filature de laine*) of M. Griolay in Paris.

"M. Collier, nearly at the same period, had occasion to erect one for his own factories. The apparatus, made under his own eyes, set up and going according to his instructions, ought evidently to be regarded as a model of action, which will be usefully consulted by all whom the subject may interest. I have thought one could not too promptly give an account of its effects.

"The whole mechanism is vertically applied at the anterior face of the furnace of the high pressure steam-engine of six-horse power. It is composed principally of a hopper, having a continual delivery, with two horizontal cylinder grinders with diamond-shaped ends (*deux cylindres broyeur horizontaux à pointes de diamant*), and two circular projectors, contiguous, placed in the same horizontal plane, which turn contrary ways and concur to produce the same effect. The coal, as it descends from the hopper, is reduced partly into small fragments and partly into powder by means of the grinders. Thus prepared it falls on the projectors in the space between their axes, and is continually thrown by them on the incandescent fire. The form of these projectors is that of a wheel composed of a straight conical shell with six trapezoidal palettes fixed vertically about it. Their velocity is about 200 turns a minute, and one may conceive that a slight degree of ventilation ought to be added to their chief effect. I have no need to add that the delivery of the combustible is easily regulated by the aid of a screw, and that the breadth between the bars of the furnace does not exceed eight millimètres ( $\frac{1}{3}$  inch).

"The whole system is of iron, and is fixed on a great and strong plate of the same metal, which is vertical and conveniently pierced on the side of the furnace. This plate being placed on castors, the apparatus may serve alternately two boilers. If we have but one to serve, it would be sufficient to fix the plate on pivots, after the manner of ordinary doors.

"The distributor thus constructed has worked for six months, and the following are the observed results:—

1st. "The action of the fuel is perfectly regular.

2d. "Every part of the combustible, or nearly every part, is burnt under the boilers.

3d. "The smoke which escapes at the top of the chimney, does not exceed the quantity of many domestic wood fires. It is also of a reddish tint, very clear, and offers none of that inconvenience to neighbourhoods which great factories using coal do.

4th. "The consumption of coal is about a tenth less than by the ordinary methods.

5th. "Small coal, which is generally at a lower price, may be used without difficulty.

6th. "The stirring of the fire (tisage) is easily done without opening the furnace by aid of a poker with a claw applied under the grate, picking from time to time the bed of the ignited coal in such a manner that it should never be more than three centimètres ( $1\frac{1}{4}$  inch) thick.

7th. "The man tending the fire having much less to do than before, could not only give more attention to the machine itself, but would have time for other kindred services. There would also be less skill required than heretofore in the attendance and management.

8th. "Lastly, the apparatus is capable of being applied to every kind of furnace already constructed, and it may afterwards be taken away without any loss of its commercial value.

"Such are the advantages which the distributor I have studied presents. From these we must deduct, 1st. the cost of the apparatus fixed up, about 1,000 francs (near 42*l.*); 2d. the value of the quantity of moving power for the apparatus, which, in the particular case in question, may amount to about a half a horse power, or one-twelfth of the total power of the engine; but it is evident these sacrifices are far inferior to the advantages of the process.

"Among these advantages there is one which, by reason of its bearing (*sa portée*) merits that I should add something concerning it; and with this I shall conclude. I would speak of the property of the apparatus being almost entirely a consumer of its own smoke. Our public laws have sufficiently provided against the dangers which steam-engines could occasion by their explosion; but it must be admitted that these regulations are but too often powerless against the inconveniences resulting from the dense smoke of machines of some power. In many places the establishment of these machines has been authorized in the midst of

habitations or but a little distance therefrom, which have been more or less depreciated in consequence of the nuisances of the smoke, notwithstanding the precautions taken relative to the altitude of the chimneys. In cities, for example, a single engine will frequently effect a serious depreciation over the surrounding house property, amounting to many millions (of francs) in value. On the other side, as these inconveniences begin to be well known, and as indeed real property (*propriété foncière*) has not less claims on the protection of Government, than manufacturing industry, the demands for establishing steam-engines in the midst of populous districts, experience opposition, more and more vigorous, from which result great obstacles to multiplying these powerful and indispensable instruments of labour, to the extent which the ever-increasing wants of civilization and commerce require. A remedy is highly desirable in the two cases I have just mentioned, and as this remedy appears to be found in the employment of the smoke-consuming distributor, I have thought it useful to mention it to the Academy. The adoption of this apparatus would satisfy the public order as to the well-understood interests of the proprietors of the engines, and it appears to me it would be well if the Administration would interfere to render the use of it obligatory. It is not here a question about an insignificant general interest; for this concerns the development of the mechanical power of France. Steam-vessels not included, there exist at this moment in the country above 1,700 steam-engines; whose total power, in round numbers, is equal to that of 22,500 horses. These machines, supposing them employed sixteen hours out of twenty-four, would every day do as much work as 45,000 horses, or that of 450,000 men working to fatigue. Their mean annual increase for six years from 1830 to 1835, has been 131 engines: and the increase for the single year 1835 was 293. Now we may fairly presume that such a progression is not likely to be arrested. It is then of consequence that the obstacle we have mentioned should be removed, and under this point of view the chances of the public prosperity will cease to have limits."

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*The Maryport and Carlisle Railway.* By J. R. A.

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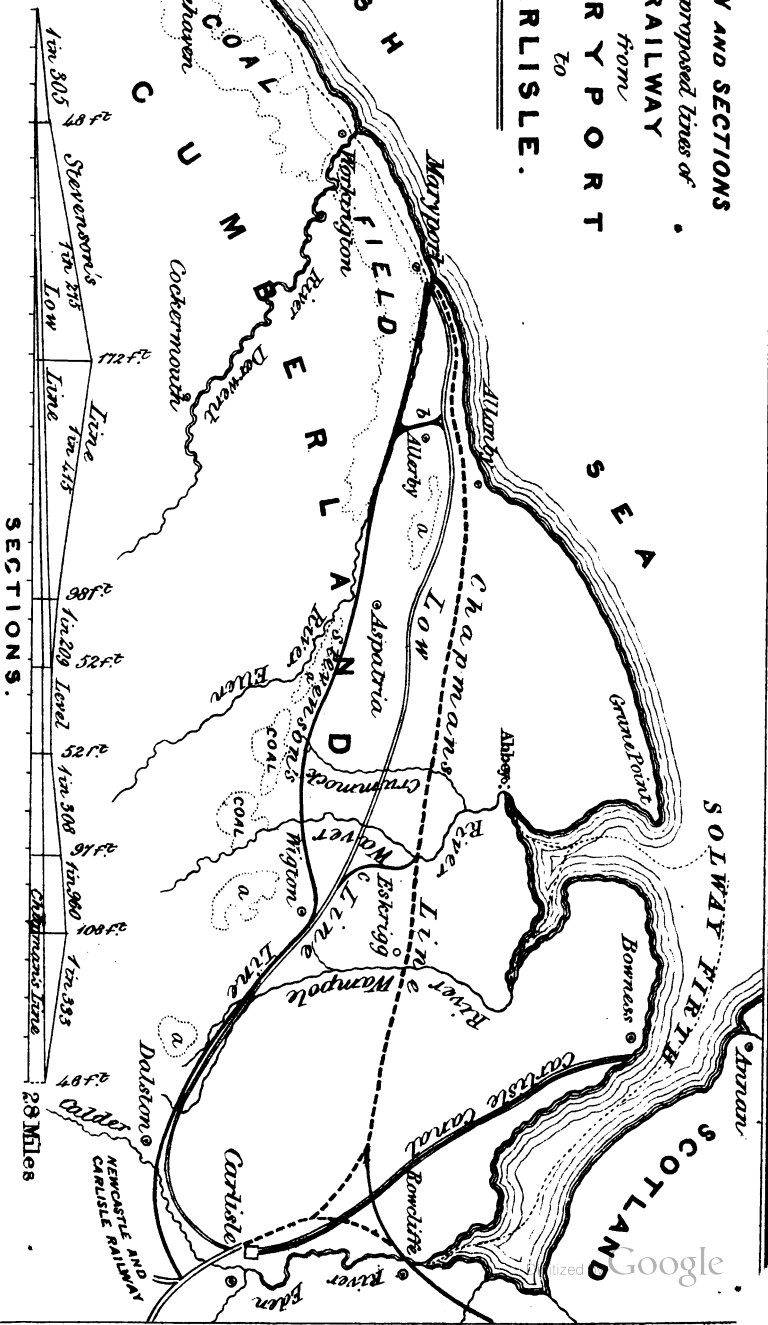
TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—The open, candid, straightforward, and, I may say, fearless manner of your treating subjects connected with railroads, emboldens me to solicit the insertion of the following observations in your invaluable publication, the *Railway Magazine*; having a thorough acquaintance of the localities of the district for about half a century, besides being the first person to draw public attention to the subject, through the medium of the press, and in producing a plan of a proposed line, which has been exhibited at Newcastle, Carlisle, Whitehaven, Wigton, Workington, &c., and also at many of the seats of the neighbouring gentry, the which I consider has been the chief means of calling forth that stimulus, that may likely end in an act of the Legislature.

This being admitted, I may well be excused the enthusiasm and anxiety I feel for its welfare, whose sole object is the producing the “*best and most economical* line, to be ascertained by survey,” that the face of the country would warrant; well knowing that *cheap roads produce cheap transit*. This is what we want; and I trust there is still sufficient energy remaining in the county to support that claim.

To proceed; after several meetings held at Maryport, Wigton, Whitehaven, &c., the Committee requested the services of George Stevenson, Engineer, who sent a surveyor, to sound the views of the proposed Company. The line chosen in consequence is up the river Ellen, past the coal and lime works of Dearham, Gilorux, and Oughterside, &c., to Aspatria; over the rivers Crummock and Waver to Wigton, past Resewen, Dalston, thence over the river Caldew, ending or abutting the Carlisle and Newcastle Railway near Botchergate. If this is to be the eventual line to be executed, no wonder it merits our astonishment, when we can point out at least two lines shorter—more level, straighter, with few cuttings or embankments, and few bridges, and of course at considerably less expense, with the speed more than doubled, if found necessary, and considerably less wear and tear into the account. One of the above proposed lines has only a rise eastward to Carlisle, and a descent therefrom to Maryport, of forty-six

**PLAN AND SECTIONS**  
*of 3 proposed lines of*  
**RAILWAY**  
*from*  
**MARYPORT**  
*to*  
**CARLISLE.**



a. a. a. a. Red Freestone.

b. Proposed line of Coal Wagon Way to Low Line.

c. Proposed line to Mytton from Chapman's Line





feet. This line was chosen by Mr. Chapman, Engineer, Newcastle, about forty-one years ago, for the formation of a canal; and should the Caledonian Railway from the Wyre, by Lancaster, Ulverston, Whitehaven, Maryport, Allonby, communicating with Wigton and Carlisle, passing over the river Eden at Rowcliffe (with a branch to Stranraer), proceeding to Glasgow and Edinburgh, this nearly level line, then, in this case, as far as respects the portion between Workington and Rowcliffe, would form part of the grand connecting link between the three kingdoms centrically, and in combination with a line across the island, in its narrowest part, from the German Ocean to the Irish Sea.

A blunder thus committed on such a situation may be considered of immense consequence, and could scarce be remedied but at very considerable cost, if not a total loss to the present shareholders. It therefore becomes eminently the duty of Parliament to consider seriously this emphatic bearing in relation to future benefits.

The other line is the one first proposed, which has been denominated the Low line, commencing on the north of Maryport Harbour, proceeding past Allonby, Howrigg, Langrigg, Seamoor, Thornby End, north of Waverton, Greenrigg, Old Windmill Tower, Wigton, between Mains and Spittall, Rosewen, north of Dalston, keeping on the western side of the river Caldew, past Cummersdale to the canal basin, with a curve to the Newcastle and Carlisle Railway bridge over the river Caldew. By this line you ascend from Maryport 52 feet, to the Wigton level, in 19 miles, 3 furlongs, with scarce any cuttings or embankments at all; you then ascend to the summit, near Dalston, 56 feet more, in  $4\frac{1}{2}$  miles, making a total rise of 108 feet, with a descent of 62 feet to Carlisle; total length of each line,  $26\frac{1}{2}$  miles.

The line up the Ellen may be said to be rich in coal and lime. If so, why have not the owners thereof long ago made railways, to take their goods to market (as is done in the coal works of Northumberland and Durham), proceeding past Allonby, or down their favourite Ellen? nor burthen the shareholders of the proposed expensive line for their particular benefit, joined to the Maryport interest in harbour dues, &c., &c. I must say it looks like a conspiracy on the subscribers and the public, to have to ascend to As-patria, 172 feet; then descend to Wigton; then ascend to Dalston; then descend to Carlisle; leaving out the noted

bathing-place, Allonby ; besides, in  $6\frac{1}{2}$  miles, the river Ellen is to be crossed 25 times by as many bridges!! with one over the Crummock, one over the river Waver, two bridges over the Wiza, three over Wampool, and one over Caldew ; besides twelve becks or millstreams ; with cuttings of 40 feet, 37, 32, 29 feet, &c., extending  $2\frac{1}{2}$  miles, for no real use, but to keep in countenance the Herculean labours of the Couran ! !

Talk about your coalfields, indeed, your lime and stone—the farmers and others on each side of the line, for the extent of three or four miles will load their own coals and lime, having horses, carts, and good roads into the bargain. Thus much they already signify. It is not, perhaps, of any very great consequence whether the above-named collieries can be warranted as to productiveness for any considerable length of time or otherwise. The collieries of Priest-croft, Bolton, and Weary Hall, are of very inferior quality, of course will soon become unmarketable ; moreover, when the Blenkinship Colliery is fairly under weigh, with one or two more that may be opened out in the neighbourhood of Halt-whistle, joined to the Tindale Fell Coal Works, whose very superior quality will eventually cause few coals to go farther eastward from the pits on the Ellen than Aspatria and neighbourhood. The Blenkinship coals are even now used in some farm-houses near Wigton, being brought by the returning market carts from the railway station, Botcher-gate ; the lime from Blenkinship will follow of course. As for freestone, little of it will be wanted any great length of the proposed railroad ; since the enclosure of the commons, about twenty-three years ago, most of the farm buildings wanted in consequence have been erected, and what repairs the rest may want will be trifling. Moreover, when the following allegations are properly answered, we will then have sufficient time by next session to ascertain, by survey, where the best line is to be found, as the subject at present seems to me at least too prematurely considered to sanction Parliamentary legislation.

Allegation 1st. In the engineer's judgment, is the line up the Ellen the best the county will admit of, for the united benefit of the shareholders and county generally ?

2d. Is the line up the Ellen preferable to any other line, in case the Caledonian Railway may in future be executed ?

3d. Will the line up the Ellen yield more passengers, by leaving out all those that may be supposed to visit Allonby during the bathing season ?

4th. Is the line up the Ellen preferable to a line shorter, more generally level, more straight, more expeditious, and of course far less expensive?

If the Committee had been wise enough to have consulted their *true interests*, they would have offered a liberal reward for the production of the best line, to be proved by survey, and by a *model* of the *district*, showing every hill and vale road, mill-stream, &c. &c., with rise and fall in feet, marked thereon; the business then would have assumed a very different character, would have given a knowledge of the country, superior to anything else, would have shown to Parliament, at a glance, the essential requisites the country would bear in the formation of a cheap and efficient line, without the possibility of party-trickery exciting an undue influence; to proceed otherwise, appears to me to despise the favouring peculiarities that Providence has liberally thrown in the way, for ingenious men to exercise their skill and talents on.

Rules may be laid down in vain for the formation of the best line, if prejudice is allowed to preponderate with such scandalous, barefaced, overbearing effrontery, as in the present instance. Are we to believe the lithographed plan and prospectus, published under the sanction of this "minute examiner," George Stevenson, engineer, that most part of the parish of Holm Cultram contains an immense bed of *red sandstone*? Where, now, alas! are the bogs of Wedholm gone to? departed for ever! or how George will contrive to congregate one-seventh of all the population of the thinly-inhabited county on this particular line, annually, I know not; except he possesses the powers attributed to the lamp of Alladin (vide "*Arabian Nights' Entertainments*." ) I propose myself the pleasure of "minutely examining" the Report to the Directors of the Maryport and Carlisle railway, as well as the "*exposition of traffic*," at an early opportunity, when we shall, I trust, exhibit the whole, nearly as true and correct as the above specimen of George's veracity.

He must not think he has the wealth of Middlesex or Lancashire to finger, in producing the splendid or magnificent, instead of the *cheap and the useful*; besides, he will have, I can assure him, the Cumberland longhorns to look occasionally at his quackery and his cobbling; and though "the public may be sore oppressed, by reason of their own ignorance," yet they shall always find an advocate in forwarding right feelings on this interesting subject, in

Yours, &c. J. R. A.

*Memoir on the Calculation of High-pressure Steam-engines, by M. Pambour, read before the Academy of Sciences, April 3, 1837.*

THE questions presented in the calculation of machines are of three kinds:

1st. The machines being supposed constructed, and its velocity of motion given to determine the resistance it could move.

2d. The machine being still supposed constructed, and the resistance it ought to move being known, to determine the velocity it could communicate to that resistance.

3d. The resistance to move being known, as well as the velocity it is necessary to give it, to determine the dimensions it would be proper to adopt in the construction of the machine, in order to produce this effect.

It is the general solution of these problems which we propose to ourselves, relatively to high-pressure engines without condensation, in the memoir of which we are now reading an extract. Our object is to prove that the theory of the motion of vapour, which we have developed in our *Traité des Machines Locomotives* and the calculations growing out of them, are not only applicable to every kind of high-pressure engines, but are indispensable for calculating their effects or their proportions.

It is for this reason, before entering on our own theory, we shall examine the means employed heretofore by others to arrive at the same object. We shall show that the first of these problems has only been resolved approximately, which one can hardly call a calculation, since it is exact in some cases only, and in all others wanders wide of the truth without our being able to assign the cause; that the formulas proposed to resolve the second are entirely erroneous in fact and theory; and that likewise the different essays undertaken have produced no analytic relation fit to determine the effects or the proportions of machines.

I. When one would resolve the first of the three questions proposed above, namely, the resistance that a machine could move at a given velocity, he takes the pressure in the boiler and considers it as the force acting on the piston; or that, multiplying it by the area of the piston, the result gives the effort the machine ought to produce, or the resistance it ought to move. But as it happens, the result thus obtained does not accord with facts, it is reduced more or less, in

order to make it as much as possible square with them. In ordinary machines the result is reduced to a third. This is the rule given by Tredgold, in his "Treatise on the Steam-engine." (P. 303, of the French translation.) It is also that adopted by M. Navier, in his *Memoir sue les Machines Locomotives* inserted in *Les Annales des Ponts et Chaussées* for 1835, pp. 16 and 23 of the memoir. Finally, it is the general reduction admitted by practical men, who express it by saying, that horses in practice are only a third of what they are in theory; yet if the calculation were properly made, there ought not to be a single pound applied of which we could not indicate the employment.

But this reduction of the theoretic calculation to a third, considerable as it is, is however not enough to arrive at the truth in many practical cases. We may read in "Wood's Treatise on Railroads," pp. 277 and 284, the calculation of five steam-engines, not locomotives, but fixed, of which two were low and three high-pressure engines, in which the real are to the pretended theoretical effects in the proportions of 26 to 100 in the minimum, and of 30 to 100 in the maximum, or more.

There are examples in which the results obtained must be reduced to a fourth. But when one applies the calculation to locomotives having great velocities, we find the real effect is not only not a third or a fourth of the theoretic, but often not a fifth or a sixth. This may be verified in an ordinary locomotive with two cylinders of eleven inches diameter drawing a load of twenty-five tons of carriages, with 50lbs. effective pressure per inch in the boiler, and a velocity of thirty miles an hour, which happens daily. We find the force applied according to the calculation is 12,635lbs., and that the effect produced is 2,466lbs. which is not the fifth; and the difference would be greater still for machines with cylinders of fourteen or fifteen inches diameter, as now constructed.

To account to a certain point for this enormous difference between theory and facts, they attribute the surplus largely to friction much exaggerated, without having been measured, and to certain losses which oftentimes do not exist. Thus, Tredgold, p. 304 of the work cited, wanting to explain the loss of four-tenths of the total power which he attributes to high-pressure engines without condensation, values the friction of the piston with the loss or escape of vapour at two-tenths of the power, and the power necessary to open the valves and the friction of the parts of the machine at six one-hundredths of this power. We are easily convinced of the

error of these estimates, and consequently of all those based on a similar system, by considering that they are referred to the *total*\* force of the machine, that is, that for a machine of 100-horse power, there must be twenty to move the piston, six to move the mechanism, &c.: the exaggeration is evident.

In applying this evaluation to an ordinary locomotive of twelve-inch diameter cylinders, and 60lbs. *effective* pressure in the boiler, we find the force of friction, as reckoned here, amounts to 5,650lbs., whilst our experiments on the Atlas engine, which has these dimensions and works with this pressure, shows that the force is only 42lbs. applied to the wheel, or 248lbs. applied to the piston, as one might see in the memoir we have recently presented to the Academy on the friction of locomotive engines.

[This does not appear to us to affect Tredgold's observations in principle, but only in quantity.—ED.]

It is then demonstrated that to resolve the first of the problems proposed, the mode employed hitherto is only a rude approximation approaching the truth to about two-thirds, three-fourths, or four-fifths of the real value.

II. With regard to the second problem, that of determining the velocity when one knows the load, Tredgold, in his work on Steam-engines, p. 156 of the French translation, undertakes to compute the velocity of the piston according to considerations deduced from the velocity of one gas of a certain density running into another of a different density. He replaces the pressure of the vapour in the boiler, and the resistance on the piston by two homogeneous columns of vapour which would produce the same pressure, and deduces from them that the velocity in feet per second, will be equal to five times the square root of the difference between the two heights.

It is obvious that this calculation does not give the velocity of the piston; for this supposes the boiler filled with an inexhaustible quantity of vapour because the running gas is supposed to be always at the invariable pressure  $p$ , however great may be the velocity it flows with on account of the difference of the two pressures. It must therefore be that the boiler is capable of generating every instant all the vapour abstracted, whatever be the rate of its current out.

\* We think M. Pambour is here drawing conclusions with a sort of railway speed. Tredgold may not be right in the amount of his estimates; but it certainly does seem highly probable that the friction of the parts, other things alike, should be very nearly as the work to be done if the power is to be as the steam pressure.—ED.

But in reality the velocity would soon be limited by the quantity of vapour the boiler could furnish per minute. If this quantity would serve to fill 200 cylinders, there must be 200 strokes of the piston; if 300, there must be 300 strokes of the piston; and it is only when the production of vapour was great enough to satisfy the above velocity, which is the greatest possible, that this velocity will be established, and not before. Tredgold's formula does not then in any way give the actual velocity, and if it was otherwise, we see that it would be indifferent whether a machine had a great or a little boiler, that it produced an enormous or a very small quantity of vapour per minute; the velocity would be always the same.

Thus this calculation agrees with no practical fact. In applying it to an ordinary locomotive drawing a load of 100 tons, we find the velocity would be 480 miles instead of 20, its real velocity.

M. Petit, professor at the Polytechnic School, and of talents well known, has made an experiment to determine the velocity of the piston in any steam-engine whatever. His calculation is inserted in many works, and particularly in Lanz and Betancourt's "Essai sur la Composition des Machines," p. 25. He takes the pressure in the boiler as the motive force on the piston. He considers it as constant as well as the resistance of the piston, and deduces for the expression of the *vis viva*, the following value:—

$$2 g \delta b (h - h') (x - a),$$

where  $b$  is the section of the cylinder,  $a$  the part of the cylinder already filled with vapour at the departure of the piston,  $g$  the gravity,  $\delta$  the density of the water,  $h$  the height of a column of water capable to represent the pressure of the vapour, and  $h'$  that which represents the resistance.

It is evident this formula cannot be applied to steam-engines. It represents circumstances which do not exist in them, and does not represent those which do exist. In the first place, it supposes the motive force on the piston equal to the pressure in the boiler; and if this was so, every calculation we have previously cited on the effect of machines, would have given an accurate result, without being obliged to make a deduction of two-thirds, three-fourths, or four-fifths.

Lastly, it supposes, moreover, as the preceding, an inexhaustible production of vapour in the boiler; for the pressure is supposed to remain constant, independent of all



possible expense of vapour by the cylinder. It can therefore be of no utility.

Tredgold, in his "Treatise on Railroads," p. 83, English edition, gives the following formula, without discussing it or founding it on facts:—

$$V=240 \sqrt{l \frac{P}{W}}$$

$V$  is the velocity of the piston in feet per minute,  $l$  the stroke of the piston,  $P$  the effective pressure of the vapour in the boiler, and  $W$  the resistance of the load. But as this formula furnishes neither the diameter of the cylinder, nor the quantity of vapour furnished by the boiler per minute, it is clear it cannot give the velocity sought; for if it was true, the velocity would be the same with a cylinder of 4 feet diameter as with one of 1 foot diameter, although the former expends sixteen times as much vapour as the latter. The surface of the furnace, or the force of the evaporation of the boiler, would be equally indifferent; a machine would not go any faster whose boiler vapourized a cubic foot of water per minute, than if it vapourized only a fourth or a twentieth of it. Thus we perceive this formula does not accord with facts. In applying it to an ordinary locomotive, drawing a maximum load, or travelling with its minimum velocity, we find the machine ought then to preserve a velocity of  $18\frac{1}{2}$  miles per hour, which is very far from the case.

Wood, in his "Treatise on Railroads," p. 351, proposes also, without discussion, the following formula:—

$$V=4 \sqrt{l \frac{P}{W}}$$

$V$  is the velocity of the piston in feet per minute,  $l$  the stroke of the piston,  $W$  the resistance of the load, and  $P$  the surplus of pressure in the boiler over that which there must be to balance the resistance  $W$ .

This formula is no better founded in theory than the preceding, since it has no term to represent the diameter of the cylinder, nor the vapourization of the engine; and it does not better accord with facts. For the case where the machine draws its maximum load, that is, when the pressure in the cylinder or the resistance on the piston is equal to the pressure in the boiler, we should have, according to this formula, the velocity  $V=0$ ; whilst in this case we know the locomotives preserve always a velocity of about 10 miles an hour, or 146 (strokes?) per minute for the

piston. For the case where the load is 50 tons in an ordinary locomotive, the velocity of the machine would be, according to the formula, about 30 feet only per minute, whilst it really is 25 miles an hour, or 2,200 feet per minute.

We see then that the attempts hitherto undertaken to calculate the velocity of the piston under a given resistance in high-pressure engines, which should have a great velocity, are not better founded than those which have for their object to determine the load; and that therefore there is no analytical formula, or any exact means for calculating the effects of these machines, nor consequently for determining the proportions proper to give to them to obtain effects desired. We construct a great number of machines, but we know not the precise effects of them but by submitting them to trial; and when we want a determined object, we are reduced to copy machines already constructed, with some modifications suggested by judgment or skilful observation, but without any certainty of arriving at the result desired.

III. We have hitherto been desirous of demonstrating the absolute want of any analytic relation between the effects and the proportions of machines. It now remains for us to show the principles on which we shall establish what we have to say.

It is well known in every machine, the effort of the moving power being at first superior to the resistance, there is produced a very trifling motion, which increases during a certain time, until the machine has attained a certain velocity which it will not surpass, the motive force not being capable of (maintaining) a greater velocity with the mass it has to move. When once the machine has attained this limit, which requires but a very short interval, its velocity continues the same and the motion becomes uniform. It is from this moment only we begin to calculate the effects of the machines, because they are never employed but in this state of uniformity, which is their regular state, and continues during the time of their working. We properly neglect the few minutes during which the velocity is regulated, or the transitory effects have place, namely, from zero velocity to a uniform velocity.

In what concerns locomotives, a great number of experiments made by the author, but unpublished, prove that the uniform motion does never require more than  $2\frac{1}{2}$  minutes to be established with the heaviest loads in starting from abso-

lute rest; which depends indeed on a great number of circumstances easily subjected to calculation.

[This is an extraordinary statement, and we should like to see the experiments. Our experiments on the Liverpool trains by no means accord with it; and we think there is no difficulty in showing its absurdity from direct theory.—ED.]

In these machines, then, as well as in all others, it is only after the establishment of a uniform motion that we commence to calculate their effects. Now when the uniform motion is attained, the power applied exactly equals the resistance; for if it was greater or less, there would be an acceleration or a retardation of motion, which is against the hypothesis. This principle is absolute with regard to machines of every kind. In steam-engines, especially, the force applied by the mover is only the pressure of the vapour *against the piston in the cylinder*. Hence this pressure in the cylinder is strictly equal to the resistance of the load against the piston. [We understood in another place M. Pambour makes the atmosphere add a resistance equal to about 14 or 15lbs. to the inch.—ED.]

Consequently the vapour, in its passage from the boiler to the cylinder, changes in pressure (de pression), and passes to that which represents the resistance of the piston. This fact explains by itself alone all the theory of steam-engines, and lays their action open.

From this we immediately deduce, that in the calculation of these machines, we must not, as it hitherto has been done, take the motive force as constant and equal to the difference between the pressure in the boiler and the resistance on the piston, which would produce a motion constantly accelerated, contrary to facts and to theory; but we must consider the accelerative force as small, because the power applied by the machine is strictly in equilibrio with the resistance, and not more. And if we had need to calculate the transitory effects which hold good during the short interval the engines are regulating their velocity, this would not even be constant, considered as an accelerative, but a variable rapidity, diminishing until it becomes null immediately the machine has arrived at its normal state.

We have, according to what precedes, the pressure the vapour really exerts against the piston. If the question simply concerned a case of equilibrium, this evaluation would suffice; but it is known in the case of motion we must, with respect to forces, consider two things—1st, the intensity of the force; 2d, the velocity with which this in-

tensity is applied. Now in the case in question, it is evident it is the velocity of production of the vapour in the boiler which indicates the velocity with which the force is applied. We cannot, then, arrive at any exact result as long as we cease to introduce this element into the calculation; and thus it is precisely why all the preceding attempts cited, to determine either the load or the velocity of the engine, have been defective.

We ought, then, to restore this essential element, so improperly neglected heretofore; that is, we ought to take account, in the calculation of the force of vaporization in the boiler, or of the quantity of water it could transform into vapour of a known degree and in a given time, and we shall then see that the question will become one of remarkable simplicity.

In effect, one sees at once that the velocity of the piston is a thing the most easy to calculate.

We know the surface of the furnace of the boiler, and consequently we could know the volume  $S$  of the water it could vapourize per minute. This water is transformed into vapour of a certain pressure  $P$ . Now we know the volume  $m$  of vapour formed under a determinate pressure. We have, then, the volume of vapour formed each minute by the boiler. This vapour passes into the cylinders; but supposing the steam-pipes and the cylinders are enclosed in the boiler, or surrounded by the hot air from the fire (*flamme du foyer*), as it is in locomotives, the vapour preserves its temperature. Then this vapour augments in volume reciprocally as the pressures. Once, therefore, transmitted to the cylinders the volume  $m S$  of vapour furnished each minute by the boiler, becomes  $\frac{m S P}{R}$ . If we

divide this volume of vapour running through the cylinder in a minute by the area of the cylinder, we shall have the velocity with which it ought necessarily to pass, and consequently the velocity communicated to the piston.

This theory, properly developed, leads to a formula expressing the velocity of the piston, where we see all the elements of the resisting force enter, namely, the force of vaporization of the boiler, the pressure of the vapour, the diameter of the cylinder, the stroke of the piston, the resistance to move, that of the air, the friction of the machinery, the increase of this friction by unity of the resistance, the atmospheric pressure, and the pressure subsisting on the face of the piston opposed to the vapour.

This formula is the following:—

$$V' = \frac{m S P D}{[(1 + \delta) R + F + (1 + \delta) r V'^2] D + \frac{1}{4} \pi d^2 l (p + p')}$$

in which the letters have these significations:—

*P* is the *total* pressure of the vapour on unity of surface in the boiler.

*S* the volume of water which this boiler could vaporize per minute at the pressure *P*.

*m* the volume of vapour at the pressure *P*, corresponding to the volume of water which has produced it.

*R* the resistance opposed by the mass to be moved, and *D* the distance advanced at each stroke of the piston.

*F* the friction of the machine, and  $\delta$  the increase of this friction by unity of the resistance to be moved.

*d* the diameter of the cylinder, and *l* the stroke of the piston.

*p* the atmospheric pressure, and *p'* the effective pressure subsisting on the opposite face of the piston.

Finally, *V'* the velocity communicated to the resistance, and *r V'*<sup>2</sup> the resistance of the air, as well against the moving mass as against the different parts of the apparatus itself.

This formula will give the velocity of the machine with a given resistance, and reciprocally we may deduce from it the resistance which the machine could put in motion with a known velocity, namely,

$$R = \frac{m S P}{(1 + \delta) V'} - \frac{F}{1 + \delta} - \frac{\frac{1}{4} \pi d^2 l (p + p')}{(1 + \delta) D} - r V'^2$$

Lastly, we may deduce from it the force of vaporization, which the boiler of the machine ought to have in order to move a given load with a given velocity.

$$S = \frac{[(1 + \delta) (R + r V'^2) + F] D V' + \frac{1}{4} \pi d^2 l (p + p') V'}{m P D}$$

In order to apply these formulas, it remains to determine experimentally four elements of the calculation which are not known *à priori*, namely, the quantities, *S*, *F*,  $\delta$ , and *p'*.

The quantity of water *S* which a boiler of given dimensions can transform into vapour under a known pressure, may be determined by the experiments of the author, in his "Treatise of Locomotive Engines;" but he proposes very shortly to publish new researches, theoretical and experimental, on this subject, which will render the determination more general and complete, and which will show that the experiments of an English engineer who has used to the present time to establish the comparative effect of the furnace

surfaces by radiation or by communication, is only a particular case not agreeing with actual boilers.

The friction  $F$  of an engine, not loaded with any resistance, will be easy to find also, after the process employed by the author in respect of locomotives, and which consists in finding what is the least pressure of the vapour in the boiler necessary to keep the engine in motion when it has to overcome its own friction only. If this pressure is  $p'$ , the friction sought will be

$$F = \frac{1}{4} \pi d^2 p' \frac{l}{D}$$

To determine the increase of the friction  $\delta$  produced in the machine by unity of resistance, it will be sufficient to augment the resistance moved by the machine, or to diminish on the contrary its pressure, until we are assured the machine is arrived at the limit of its force, with the pressure it has to dispose of. If then  $p''$  is the effective pressure in the boiler, and  $R''$  the resistance, the additional friction  $\delta$  will be determined by the equation

$$R'' + F + \delta R'' = \frac{1}{4} \pi d^2 p'' \frac{l}{D},$$

which has no unknown quantity except  $\delta$ .

Lastly, with regard to the pressure  $p'$  on the face of the piston opposed to the access of the vapour, some researches recently undertaken by the author of this memoir, and supported by considerable experiments made with special apparatus, will afford the means of fixing the determination of it. This will be the object of a memoir which M. Pambour proposes forthwith to bring under the notice of the Academy. There will at the same time be seen the effect of the contraction of the passage for the exit of the vapour, on the vaporization of engines, their velocity and their load; and these researches, joined to others on the velocity of flowing of the vapour through determinate orifices, will serve to fix the dimensions for the passage of vapour in engines; dimensions which at present have not been regulated but by rules drawn from custom.

In making the application of these formulas to locomotives, we find a complete coincidence between facts and calculation. It is on locomotives that we have always made the proof of them, because of the exactness with which we can appreciate the resistance overcome by the machine and the velocity of motion, circumstances which, joined to the facility

with which one can change at pleasure the velocity and load, have made us consider these engines as the most proper to found a true theory on of the steam-engine in general.

We see then that the theory of the motion of vapour developed above resolves immediately, and in a completely analytical manner, the questions proposed on the subject of high-pressure engines, questions which, as we have seen, have hitherto remained without a solution.

This theory applies equally to any other engine whether of high or low-pressure, as the author proposes to show hereafter, after he has completed the new researches with which he is occupied relative to locomotives.

*Avery's Rotary Engine.* By the EDITOR.

WE copy the following letter of Mr. Avery from the *American Railroad Journal*. We do not of course presume to contradict experiments; but the stated performance of his engine appears to us somewhat extraordinary when tested by computation. For instance, 1000 revolutions per minute of a wheel six feet radius gives  $16\frac{2}{3}$  revolutions per second, and therefore a velocity at the circumference of  $16\frac{2}{3} \times 12 \times 3.14159 = 628.318$  feet per second, or about 428 miles per hour. Now steam will not enter a vacuum, faster than about 1,300 feet per second. One half nearly therefore of its power is lost by the retreating of the arms. In this case we sink the retardative effect of the steam mass on the arms, as it ascends, in the retreating of the arms. Now if  $p$  be the lbs. pressure of the atmosphere per square foot,  $v$  the revolving velocity of any point on the arms,  $x$  distance from the axle, and  $b$  the breadth of an arm exposed to the action of the resisting air,

$$2 \int \frac{bpv^2 x dx}{1100^2 \times 6} = \frac{2 \times b \times 15 \times 144 \times 628^2 \cdot 3 \times 6^4}{1100^2 \times 6^2 \times 4}.$$

is very nearly the total resistance of the atmosphere to the motion of the arms in lbs. applied at the extremity. If then

$b = \frac{1}{12}$  or the arms present only one inch of breadth to the atmosphere (we think we have seen it stated they are two inches broad, which would double the result,) we shall have 176lbs. for the resistance of the atmosphere to the motion of the arms exerted at the same points at which the steam is exerting  $120 \times \frac{3}{16} \times 2 \times \frac{1}{2} = 22\frac{1}{2}$  lbs.

But it is said the arms work in a case, and that the air is very much rarified within. Be it so; we still cannot comprehend how it could be so rarified as to reduce 176lbs. to 22 and under, which it must to keep the engine in such rapid motion. Besides, will not the very egress of the waste steam from one arm, afford a resistance, confined as the steam is to the following arm, and with an augmented velocity too over and above quiescence of 650 feet per second?

We offer the above remarks as a hasty and imperfect sketch of the difficulties which calculation throws over the statement of Mr. Avery in the following letter; we shall be happy to see them explained.—EDITOR.

*To D. K. Minor, and Geo. C. Schaeffer.*

GENTLEMEN,—I am now able to give you a good account of the grist or flouring-mill put up at Cato, for Corners in Cayuga county. It is now in successful operation and works beyond our expectations.

You will recollect that we have put up an engine there with arms of *twelve feet* in diameter with the shaft placed perpendicular, receiving the steam at the lower end, which, when worked at 120lbs. to the square inch, will nearly raise the shaft and arms from their bearing below, and therefore work with very little friction. This engine makes about 1000 revolutions per minute, and the works are driven by cog-wheels, instead of bands, as in the smaller engines, and we can give the stones any velocity we desire.

This engine was designed to drive *three run* of stones, and to use steam at 120lbs. of the square inch, and to grind 100 bushels of wheat to the cord of wood; and these anticipations have been more than realized, as we have the three run in operation, and grind eight bushels per hour, to each run, with *less* than 60lbs. of steam to the square inch; and usually not to exceed three-fourths of a cord of wood to the 100 bushels. Another run might be driven with great ease.

The apertures in the arm of this engine are *each*  $\frac{3}{16}$  of a square inch, but it is intended to reduce them *one half*, at least, and use steam at 120 to 150lbs. to the inch, when I have no doubt of being able to grind over 150 bushels of wheat with a cord of *maple wood*. Since this mill was put in operation, two other companies have been formed to erect two other mills on the same plan, for flouring.



This experiment sustains my theory, that the long arm is best, and I intend to make an engine with twenty feet arms, which I have no doubt will work *one hundred horse power*.

I have many interesting facts, and shall have others in a few days, in relation to the rotary engine in this mill, which I will communicate to you, and in time, I hope for the next number of the *Mechanics' Magazine*. In the mean time,

I am, truly yours,

Syracuse, Dec. 12, 1836.

WM. AVERY.

### *Demonstrations of Dr. Pell's Theorem.* By J. J.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

The following theorem, though not remarkable on its own account, is rendered interesting to the mathematician from several circumstances connected with its history; especially from the number of different demonstrations that have been given of it. It was originally proposed about the year 1650, but without proof, by Dr. Pell, in his refutation of Longomontanus' quadrature of the circle. In the course of the controversy he applied to his mathematical friends for demonstrations, and received two from Roberval, one from Hobbes, one from Cavallieri, besides five others from authors of less note. To these nine six others were afterwards added, but without the author's name, in a periodical entitled the "British Oracle," published about 1769. The two following seem also to be different from any of the preceding.

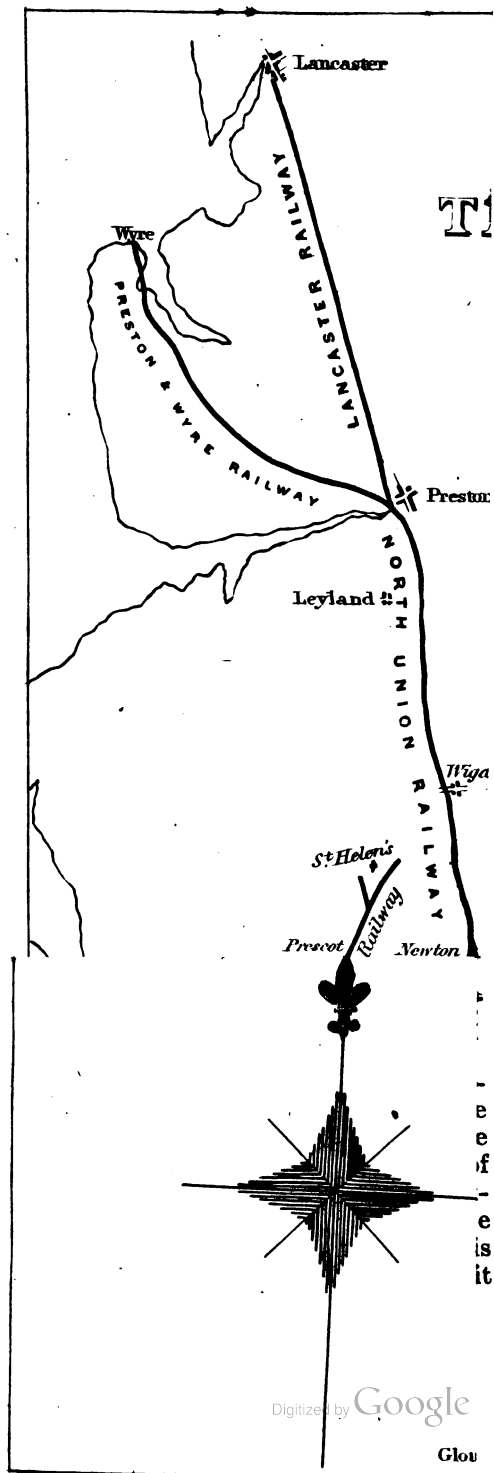
#### *Theorem.*

Let  $ABC$  be a triangle, right-angled at  $C$ , and let the angle  $B$ , be bisected, by the straight line  $BD$ , meeting  $AC$  in  $D$ , then,  $2BC^2 : BC^2 - CD^2 :: CA : CD$ .

Or, trigonometrically,  $\tan. 2a = \frac{2 \tan. a}{1 - \tan.^2 a}$ .

For,  $AB : AD :: BC : DC$  (3. 6, of Euclid);  $\therefore AB^2 : AD^2 :: BC^2 : DC^2$  (22. 6); and,  $\therefore AB^2 : AB^2 - AD^2 :: BC^2 : BC^2 - DC^2$  (17. 5);  $\therefore AB^2 : BC^2 :: AB^2 - AD^2 : BC^2 - DC^2$ ; and,  $\therefore$  by (17. 5), and by putting for  $AB^2$ , its value  $AC^2 : BC^2 :: 2DC^2 + 2DA \cdot DC : BC^2 - DC^2$ , or  $2AC^2 : 2BC^2 :: 2AC \cdot CD : BC^2 - DC^2$ ,  $\therefore 2BC^2 : BC^2 - CD^2 :: AC : CD$ . Q. E. D.

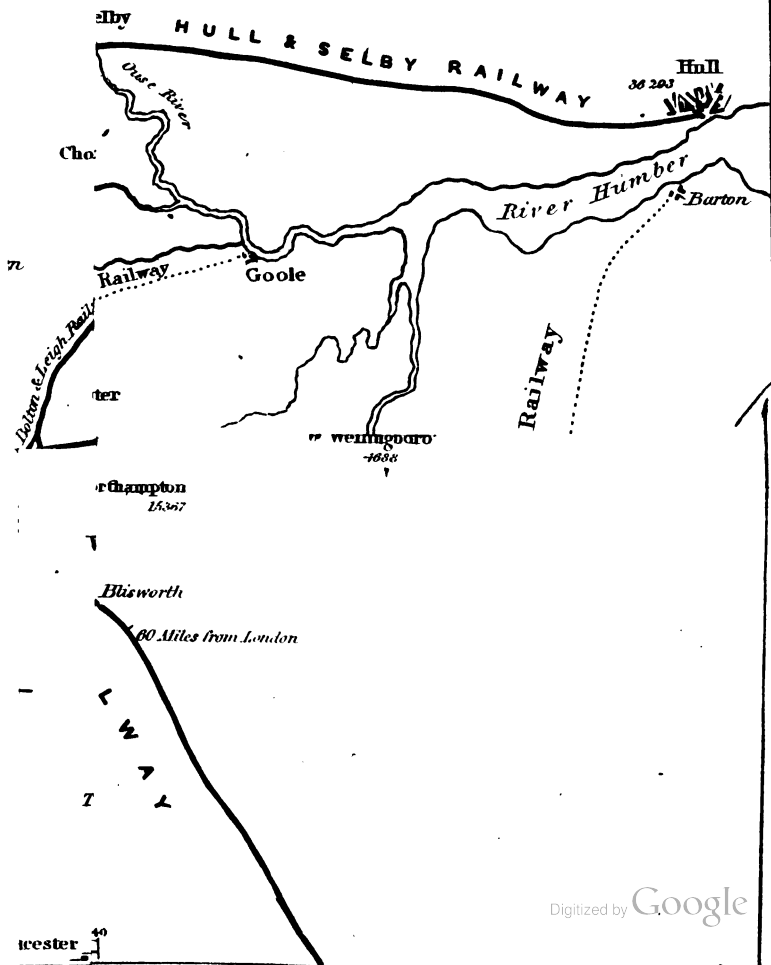
Otherwise. Because (B. 6)  $AB \cdot BC = BD^2 + AD \cdot DC = BC^2 + CD^2 + AD \cdot DC$  (47. 1)  $= BC^2 + AC \cdot CD$  (3. 2);  $\therefore AB \cdot BC - BC^2$ , or  $BC (AB - BC) = AC \cdot CD$ ; and,  $\therefore BC : CD :: AC : AB - BC$  (16. 6);  $\therefore BC^2 : DC^2 :: AC^2 : (AB - BC)^2$  (22. 6); and,  $\therefore BC^2 : BC^2 - DC^2 :: AC^2 -$



## REFERENCE

*Midland Counties Railway, in progress***THE** *other Railways for which Acts have been obtained*

YORK

*Projected Railways**Population of each Town in Figures, according to the Census of 1831*

$(AB - BC)^2$ ; but  $AC^2 = AB^2 - BC^2$ , and  $(AB - BC)^2 = AB^2 - 2AB \cdot BC + BC^2$ ; and,  $\therefore BC^2 : BC^2 - DC^2 :: AC^2 : 2AC \cdot CD$ , or  $2BC^2 : BC^2 - CD^2 :: 2AC^2 : 2AC \cdot CD$ ; and,  $\therefore 2BC^2 : BC^2 - CD^2 :: AC : CD$ .  
Q. E. D.

These two demonstrations differ from the fifteen above-mentioned, principally in this, that they require no additional lines to be drawn, nor any preliminary construction.

The reader will find an interesting account of this theorem, together with the other fifteen demonstrations, in an excellent tract on the geometrical analysis of the ancients, at the end of Mr. Barlow's "Theory of Numbers."

*Edinburgh, March 20, 1837.*

J. J.

### *Theorem in General Differentiation and Integration.*

By the EDITOR.

WE shall here give a curious theorem discovered about the year 1827, and inserted in a treatise written by us at the request of Mr. now Lord Brougham, on the Differential and Integral Calculus, for the "Society for the Diffusion of Useful Knowledge," but which treatise, owing to certain circumstances, we declined to let the Society have.

$$d_n^t d_x^n \sin x = \left(\frac{\pi}{2}\right)^t d_x^{t+n} \sin x.$$

That is the differential coefficient with respect to  $n$  of the  $n$  differential coefficient of  $\sin x$  is equal to the  $t+n$  differential coefficient of  $\sin x$  multiplied by  $t$  power of the quadrantal arc to radius unity. The orders of differentiation may be either positive or negative, whole or fractional, or any numbers whatever; so that differential and integrals of every order are included, and the theorem has all the generality of powers.—ED.

### *Midland Counties Railway.*

WE are glad of the opportunity of affording some information on the subject of this railway to our readers, and have taken some pains to arrive at a correct statement of the present state of the works, and of the expectations of success of this line, which has been thrown into the background by the various rival lines which appear to have gradually withdrawn, and are now about to leave this railway in undisputed possession of the ground which it originally occupied.

The Midland Counties Railway is the main north and north-east artery of the London and Birmingham Railway, and although the most important feeder of that main trunk, and one which will hereafter bring the largest portion of profitable business, it has been treated all through with remarkable neglect by the proprietors of the London and Birmingham, and through them by the public; probably because the Midland Counties Railway, from having originally had its subscription list filled by a numerous body of persons locally interested in its success, and who, intending to keep their shares, have never hawked them on the Stock Exchange. We are not sorry to have a fair opportunity of awakening the attention of our readers to the remarkable fact, that all the prominent quotations of railway shares and transactions are of lines whose directory, either altogether or in part, hold their boards in London. We are acquainted with several flourishing concerns, whose existence is wholly unknown to the Stock Exchange speculator, or if heard of by him, only to be treated with neglect, and probably ill spoken of, because he happens to have no friend among the directors, or no London member of the board from whom he can pick out daily information to speculate with in the city in the morning, or to jabber about over his wine in his suburban retreat. In short, whenever we see a railroad, both of whose termini are distant from London, and the natural resources of which are to be sought for in country intercourse, and that line with a London board of directors, we instantly set down in our minds such a scheme as a stock-jobbing speculation. What can a London board know of the true interests of a concern whose nearest point to them is 100 or 130 miles from the metropolis? But to return to the Midland Counties Railway.

This railway had its origin entirely among the bankers, merchants, manufacturers, land and mineral owners of Leicestershire, Derbyshire, and Nottinghamshire. During several years previous to the great speculating period of 1835-6, the line of country had been examined by several eminent engineers. It was not a hastily concocted scheme, but had more levelling probably bestowed to fix the proper course, than any line hitherto brought forward. The result was to produce one of the best lines as to gradients and economy of construction; and for the tables of traffic in goods and passengers which we have inspected, probably also one of the most remunerative. Remunerative from much more

solid sources and from better prospects, and deduced from calculations founded on much sounder principles than many lines which have put forward more flourishing statements.

The Midland Counties Railway leaves the London and Birmingham Railway at Rugby, at about 80 miles from London, and proceeds in nearly a direct course to Leicester, a distance of 20 miles. The town of Leicester is passed in a manner highly advantageous for the local traffic. From Leicester the course is about N. N. W., parallel to the river Soar, and keeping exclusively on the east side of the valley, except near Loughborough, to which town the railway approaches very closely, and then traversing several populous villages, will cross the river Trent a little below Sawley Bridge, and close below the confluence of the Soar with the Trent, and of the Erewash canal with the latter river.

Two arms here extend east and west to join a transverse line connecting the important towns of Derby and Nottingham, which thus complete their communication with the metropolis, and with each other, in the most easy and least expensive manner.

By casting a glance over the map of the Midland Counties Railway our readers will see the numerous and important ramifications, which connect with other lines, and that it occupies a central and commanding situation;—indeed, it is well known that the local traffic between Derby and Nottingham, Loughborough and Leicester is in itself quite sufficient to maintain railway communications between them. The main trunk then remains as the channel whereon all the immense trade and population of Yorkshire and the north,—and on the other hand the agricultural produce from the fertile plains of Lincolnshire on the east—will be conveyed towards London; to effect which no more *extra expense* is requisite than to make the twenty intervening miles from Leicester to Rugby.

A most industrious report has been propagated that this portion of the Midland Counties Railway had been struck out of this Bill in Parliament last session. This is wholly incorrect. Certain restrictive clauses were introduced as to the period of commencement of the works, which clauses are now wholly inoperative, and we have it on the best information that on the 1st of August next, the portion of the works from Leicester to Rugby, will be commenced; nor could this commencement have been made sooner, as the principal engineer, Mr. Vignoles, has been constantly engaged

ever since the passing of the Act last year, in laying out the other parts of the line—those parts which will be soonest completed, and which will bring an immediate and lucrative return from the local traffic.

The whole of the line of railway between Derby and Nottingham has been let some weeks since to respectable contractors, and at prices satisfactory to the Company; and we have heard and believe, though of course we cannot positively know, that the amount of the lettings are within the estimates of the engineer.

Another portion of the line from the Trent to Sutton Bonnington was let last week to parties equally respectable, and on terms equally satisfactory, and in the course of another month the remainder of the line to Leicester will be ready for the contractors.

Negotiations have been opened with all the principal land-owners, and every thing is in that train, which bespeaks the utmost alacrity and attention, having been bestowed by the Directors in fulfilling their trust.

Mr. Thomas Woodhouse, who is well known as a gentleman of great experience and judgment, has been appointed resident engineer with a proper staff of assistants.

It has given us much satisfaction to learn that the disputes between the Midland Counties Railway and North Midland Railway, have been finally adjusted, and that the two companies are now united on the most friendly terms. By means of the North Midland line the traffic from Sheffield, Rotherham, Barnsley, Wakefield, Leeds, York, &c. &c., will be conducted over the Midland Counties Railway; and by means of the Sheffield and Manchester Railway there is no doubt that a considerable portion, even of the Manchester traffic, will come also.

Attempts were made during the last and present session of Parliament to bring forward a line from Leicester through Market Harborough and Northampton, to join the London and Birmingham Railway at Blizworth. The subscription list for this line, which is called the "South Midland Railway," has been consigned to Mr. Warburton's Committee, a "*hourn*" from whence no Railway Bill referred to it has hitherto returned. It is like putting the Bill into a condemned cell. This same South Midland requires a capital of 1,200,000*l.*, and it *would save four miles between Leicester and London!* The line from Leicester to Rugby, as appears from the report of last year's Committee on the Midland Counties Railway, will only cost 300,000*l.* In other words, an extra expense of nearly a million is proposed

to save four miles of distance, or ten minutes of time, 100,000%! to save a minute. Why, this *minute* saving would make one hundred miles of Railway in America.

The portion of the Midland Counties Railway between Derby and Nottingham will be finished by the summer of 1838, and we understand that here Mr. Vignoles's plan of continuous bearings by Kyanized longitudinal timbers will be tried on a great length of railway track.

*A Question relative to Mechanical Economy of High-Pressure Steam.*

TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—Observing in your number for February observations on Steam Navigation, by Mr. John Moore, of Bristol, who, after describing the best method of constructing a vessel for such a purpose agreeable to his opinion, (but Doctors sometimes differ,) states that when the steam is about 30,720lbs. per square inch the engine becomes useless; but I have somewhere read a work in which it is stated (after carrying the pressure to as high as 56,000lbs. on the inch, should the generators be made strong enough to bear this pressure) that although the mechanical action will not be double, yet it will be increased much more than the consumption of fuel. As this point seems to carry with it some weight, while steam navigation is so largely on the increase, probably, Mr. Editor, you will, with your usual urbanity, favour your readers with your opinion, for if the mechanical action is increased, at a less consumption of fuel, certainly more speed will be obtained, which is of vast importance in long voyages performing by steam vessels. I remain, Sir, your obedient servant,

NAUTICUS.

[Theoretically speaking, the elasticity of the vapour increasing in a much higher ratio than the temperature, and therefore, the mechanical effect of the vapour, which, other things alike, is nearly proportional to the elasticity, increases also in a much higher ratio. But there is to be deducted from this, the effect of the augmented pressure on the friction of the machinery, and of the greater loss of heat by radiation, conduction, &c., which latter likewise follows a ratio much higher than that of the temperature. Therefore, the mechanical effect is greater, and we should presume the



economy is greater in the use of high-pressure engines than in that of low; but not to the extent theory would give. It must also be recollected, the danger too is greater.—ED.]

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EXTRACT FROM A LETTER TO THE EDITOR.

*Bristol, March 18th, 1837.*

SIR,—In my communication to you upon cutting steam off at parts of the stroke, I omitted stating the steam's ingress and regress should have the like area of the steam cylinder.

Also, in the suggestions on steam navigation, the length of the vessel would determine the length of the axis of the catenary curve. Yours, respectfully,

JOHN MOORE.

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“ROYAL SOCIETY AND MR. HERAPATH.”

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[At the request of numerous friends we intend to publish the correspondence which led to the publications that excited so much interest some years since, and terminated in the expulsion, or forced retirement of Sir Humphry Davy from the Presidency of the Royal Society.]

(I.)

*Bristol, Knowle Hill, January 23, 1820.*

Sir,—Having been introduced to you at Mr. Perry's, of Winterbourne, about eleven years ago, and having since then met with some success, as I think, in unfolding a principle, which seems to account mathematically for the laws and phenomena of gaseous bodies, heat, gravitation, &c., I have taken the liberty of writing, to ask if you will have the goodness to present a memoir, containing some of the fundamental propositions to the Royal Society, to have their judgment upon it. It is not for me to speak of this memoir—(which, if you will have the kindness to present, I will endeavour to make as worthy of you and the R. S.'s acceptance as I can)—but I hope you will not imagine, I am unacquainted with the difficulty of the undertaking, or the efforts of others in the same track. You would perceive that my ideas, except in some particulars, are not new; they were known to Newton, from whom indeed I have borrowed the principal hint. However, I will not now take up your time with any description of these things, I only beg to inform you, that should you have no objec-

tion to grant me this favour I would transmit the memoir as soon as possible, either in single sheets, as I proceed in the copying of it from my MS. or all at once, whichever way would be the more acceptable. A line in reply would much oblige, Sir, very respectfully, your obedient humble servant,

(Signed) JOHN HERAPATH.

To Davies Gilbert, Esq., M.P.,  
Holles-street, London.

(II.)

*East Bourne, January 27, 1820.*

Sir,—I have been favoured with your letter of the 23d, although my family have left Holles-street for some years.

It will give me pleasure to receive the speculations you are so good as to offer to the Royal Society. But I must refer you to the first page of each volume of their transactions for a declaration of their declining as a body, to give their opinion on anything submitted to them.

The usual practice of the Society is as follows:—When a communication is offered, the individual receiving it consults those most conversant with the subject, and is guided by their judgment in presenting it to the Society. If he presents the paper, it is almost always read, after which it is, in its turn, considered by the council, who finally determine on the question of printing. A paper after being read is never returned, but in the event of its not being printed, the author is allowed to have a copy taken if he wishes it.

I presume that the best way of transmitting the manuscript will be altogether, by a coach; more especially, as I shall not be in London till Parliament meet. The parcel may then be addressed to me, at the apartments of the Royal Society, Somerset House.

I trust that an interval of eleven years will apologize for my not recollecting a name; if you happen to see Mr. Perry, I shall be much obliged by your remembering me to him. I remain, Sir, your very obedient humble servant,

(Signed) DAVIES GILBERT.

To John Herapath, Esq.

(III.)

*Bristol, Knowle Hill, May 24, 1820.*

Sir,—I beg to inform you that I have at length finished and sent to Somerset House the memoir you were so good as to say you would receive for the Royal Society. I regret much the length of time that has elapsed since I promised it, but when you consider the difficulty and length of the undertaking, that a great part of it, particularly of the last Scholium, has been discovered since I wrote to you, that nearly all the rest has been obliged to be entirely recomposed, that the whole of it has been written

twice over, and that I have but a very small portion of time to devote to those things, I hope you will not see very great reason to accuse me of negligence. I regret also, that I had not the pleasure of seeing you when you were in Bristol some time since, as I have been informed by my friends Messrs. C——d and F. C——y you were, for I should then have been enabled to explain the cause of my delay as well as some other things respecting this memoir.

You will now have to judge for yourself of the merits of this memoir. If it appear to you to have sufficient to present to the Royal Society, I shall be happy if you will do it as soon as you conveniently can, and should it appear to them worthy of a place in their Transactions, I shall likewise feel obliged to have it inserted in their next volume. My object in making these requests is to avoid as much as I can controversy respecting priority. You will easily perceive that I have been studious throughout the whole of this memoir to give no offence by speaking lightly, or exposing the errors of any one, and that I have taken some pains to make my principles clear and easy to be understood, and to clothe my ideas in a plain and unornamented garb. By these means, I hope to conciliate our scientific men, and to avoid any vexatious disputes. Should, however, my paper be made public, and any dispute arise on any parts of it, I shall endeavour to explain them as well as I can, and if they be fairly refuted I will readily give them up. The only things I request of the Royal Society are, that should such things happen they will have the goodness to see justice done to all parties, and assist me in making any experiments that may be necessary for examining the truth of my positions.—[B.]

[B.—This shows the then want of information of the writer respecting the Royal Society, and the mistaken notions he entertained of them.]

I now beg to inform you of the reasons for presenting my ideas to the Royal Society, in what you will, perhaps, think a crude and imperfect state. Some months ago, namely, in August last, I was weak enough to permit a friend to announce in the *Philosophical Magazine* my having completed the problem of gravitation; in consequence of this, it has been strongly represented to me by some of my friends, that from the nature of my situation, if I do not after so public a declaration give some exposition of my principles, I shall not only expose myself to the attacks of the malicious and ill-natured, but also run the risk of sinking in the good opinion of others, who, judging by the ill-success that has hitherto attended efforts of this kind, may be induced to attribute the announcement to a very different cause to that which occasioned it. Under these circumstances I have yielded to the solicitations of my friends, though many years before I intended.

Should your not recollecting the circumstances of my introduc-

tion to you at the late Mr. Perry's induce you to think the manner in which I have mentioned you in the second page of my memoir, one of those paltry compliments too often paid in public, I beg leave to assure you it is nothing but a just acknowledgement due from me to you, for the kind directions and encouragements you then gave me. Perhaps, at some future period, I may have an opportunity of recalling the circumstances to your recollection.

As I naturally feel some anxiety for the fate of this my first communication to the Royal Society, I should be exceedingly obliged, if not giving you too much trouble, to give me some information respecting it as early as you can. I am, Sir, very respectfully, your obedient Servant,

(Signed) JOHN HERAPATH.

To Davies Gilbert, Esq., M.P.

(IV.)

45, *Bridge-street, Westminster, June 6, 1820.*

Dear Sir,—I had some time since the pleasure of receiving your very curious disquisition on the cause of gravity. I read it over; and, although I must confess myself not satisfied with the ultimate deduction, yet I was much pleased with the great ingenuity displayed throughout the whole; but I entertained strong doubts on the propriety of laying before the Royal Society, any thing so abstruse and metaphysical. I, therefore, desired two of the best mathematicians in London to look at the premises; and their opinion have confirmed my doubts. They say, that such a work should be laid before the public in a separate form. I cannot present it to the Royal Society in opposition to their opinions, and consequently I must wait your direction to dispose of the treatise in any other manner that you may have the goodness to direct. Believe me, dear Sir, your very faithful humble servant,

(Signed) DAVIES GILBERT.

To John Herapath, Esq.

(V.)

*Knowle Hill, Bristol, June 8, 1820.*

Sir,—I have just received your favour of the 6th instant, in reply to which I beg to inform you that as business will call me to London in about a fortnight, I will trouble you to keep my memoir until that time, when, if you will allow me, I shall be happy to have the pleasure of calling on you to hear something further respecting the objections of yourself and friends. I am, Sir, your obedient servant,

(Signed) JOHN HERAPATH.

To Davies Gilbert, Esq., M.P.

[About a fortnight after the date of this letter the writer went

to London, and had two interviews with Mr. Gilbert. In the first Mr. G. wished to persuade him he was wrong, and attributed several things to the author not in the paper. He admitted that it was probable no mathematician could refute the demonstrations, and that the conclusions perfectly accorded with facts; but observed "that the principles themselves may be false." He particularly objected to the principle Newton has so completely established, of perfect hardness in the ultimate atoms, and at length confessed that he had not had leisure to read a paper of such length and difficulty. In the second interview Mr. G. promised to have the memoir better considered, and the author undertook to try some experiments on heat alluded to in it, and referred to in No. 6.

Want of leisure very probably was one cause of Mr. G.'s not being able to master the paper; but it is also highly probable that the known difficulty of the subject, and the failures of others in the same inquiry, operated to prevent his finding that leisure, and to prejudice him in the belief that, "where many had failed it is not likely another could succeed." But whatever may have been the cause it was very unfortunate, as a little care might then have prevented all the unpleasantness that afterwards followed; and whatever had been the result, it no doubt would have been advantageous to science.]

## (VI.)

*Bristol, Knowle Hill, September 16, 1820.*

Sir,—I lose no time in informing you that I have after some difficulty in procuring good thermometers for a high range, tried the grand experiment for deciding the truth of my views respecting the laws of temperature. The results were such as I expected, and are, I think, so decided a confirmation of my theory of heat, and consequently of my theory of gravitation, &c. that I apprehend no one who is not determined to maintain his prejudices against the influence of facts, will for a moment dispute the accuracy of the principles I have adopted, after he has read an account of the experiments I have made. I took about  $1\frac{3}{4}$  lb. mercury at  $479^{\circ}$  Fahrenheit, and mixed it with an equal quantity in weight at  $67^{\circ}$ , and after making every correction which was necessary I found the resulting temperature  $358\frac{3}{4}^{\circ}$ ; by my formula it should be  $258^{\circ}$ , but by the old theory it ought to be  $\frac{479 + 67}{2} = 273^{\circ}$ , that is  $15^{\circ}$  higher. In another experiment I mixed equal weights of mercury at  $386^{\circ}$  and  $67\frac{1}{2}^{\circ}$ , and found the temperature of the mixture about  $216\frac{1}{2}^{\circ}$ ; my formula gives  $217\frac{1}{4}^{\circ}$ , which is  $9\frac{1}{2}^{\circ}$  below the arithmetical mean of  $67\frac{1}{2}^{\circ}$  and  $386^{\circ}$ . A third experiment presents a similar coincidence, but I think it at present unnecessary to trouble you with it.

If you have any desire to see these experiments in detail as an

appendage to my memoir, I shall be happy to send them. I shall, however, have to request that you will afterwards have the goodness to inform me, as soon as convenient, whether any obstacle remain to your laying the communication before the Royal Society. Should there be any I shall have no alternative but to bring it before the public without delay, for my scientific character is so much involved in the fate of this memoir, that I must either publish it, or be considered by my friends a mere pretender to science. I am, Sir, your obedient humble servant,

(Signed) JOHN HERAPATH.

To Davies Gilbert, Esq., M.P.

(VII.)

*East Bourne, October 25, 1820.*

Dear Sir,—I am extremely sorry that your letter should have remained so long unanswered, the fact is, your letter reached this place soon after I had left it for Cornwall, and then my time was so much engaged with matters of business as to prevent my attending to anything else.

I must beg leave to assure you that I am not answerable in respect to your paper and the Royal Society. You would, of course, wish to avoid the inconvenience of its being read before the Society, and then not ordered for printing by the council. I, therefore, endeavoured to ascertain the opinions of some members of the council, who are usually looked up to on such occasions, and they considered the investigations as too theoretical for the Transactions, without taking on themselves to judge of the mathematics. There will be elected a new president, and in part a new council, on St. Andrew's day, (November 30). I shall be most ready to put your paper with the experiments into the new president's hands, to deliver them to the meeting, and have them read at all events, or to return the paper next week, when I shall go to London, to attend a meeting of the Board of Longitude. Believe me, dear Sir, your very faithful humble servant,

(Signed) DAVIES GILBERT.

To John Herapath, Esq.

(To be continued.)

## REPORTS.

### LONDON AND CROYDON RAILWAY COMPANY.

THIRD HALF-YEARLY GENERAL MEETING OF THE COMPANY,  
HELD ON TUESDAY, 7TH DAY OF MARCH, 1837.

WITH the exception of two or three properties not of magnitude, the purchases of land along the line, from the point of junction with the Greenwich Railway for the length of about two miles are

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completed, and possession obtained. The lands required from the station at Croydon, for some length towards London, are also in possession of the Company, except one or two properties, negotiations for which, are also in progress.

We have the satisfaction to state that these properties have, with one exception, been obtained by amicable agreement, or by reference to arbitration. The only case which was referred to a jury, and the amount of verdict given, compared with the magnitude of the claim, will, it is presumed, so operate in all other cases, as to enable the Company to obtain possession by agreement or reference, on the fair and liberal terms which they have offered on all occasions.

In order fully to inform the proprietors on this subject, it may be necessary to remind them, that in addition to the funds required for the line of railway between the junction with the Greenwich Railway and New Cross, it has been for some time fully understood, that in consequence of the curves and devious course of the canal, which are inapplicable to the construction of a railway, some further purchases of land would be required along the line from New Cross to Croydon. In the course, also, of the discussions in Parliament last session on the Brighton Railway, strong prejudices were created against the inclined plane of 1 in 78, leading from New Cross to Forest Hill, as originally designed. The consequent alteration in the gradient of this plane from 1 in 78 to 1 in 100; the somewhat deeper cutting to which they give rise; the greater amount of spoil bank created thereby; and the diminution of the curves of the railway; all of which were pressed upon the attention of this Company during last session by the competitors for the Brighton line to which this railway will be the access, have occasioned an increase in the estimate of expenditure for earthwork, and the lands to be purchased.

Upon examination of the revised estimates of cost for the whole undertaking, it appears that the total sum required for the purchase of land and houses, and for compensations, (including the verdict and costs of the Croydon Canal) will amount to the sum of 92,372*l*.

Immediately after the last General Meeting in September, your Directors met the several parties to the then projected contract for the execution of the works of the first section of the Railway, extending from the junction with the Greenwich Railway, for a length of 1 mile 70 chains; this contract would have included first, the brick-work, consisting of viaduct and bridge over Surrey Canal; and secondly, the embankment and earthwork.

Finding on examination of the tenders that they had been made under the prevailing belief of the continued high range of prices for labour, materials, and profits, your Directors declined all the proposals; and having divided the principal portions of work into three parts, they have been all subsequently contracted for, at prices more satisfactory to the Directors, upon comparison with the engineer's estimates.

The bridge at New Cross, and the side walls to the New Cross station, and the culvert drain under the New Cross bridge, are now entirely finished, to the satisfaction not of the Company only, but of every person who has inspected them; the completion of the viaduct, &c. is limited by contract to six months from the time of commencement. The earthwork and embankment have been for some weeks past in active progress: the completion of this work (the duration of which regulates the time for completing the entire undertaking) is limited to fifteen months from the 12th of December last; if, instead of an excessively wet season, the remainder of this year should present the ordinary average of favourable weather, this work will probably be completed by the 31st December next.

The greater part of the works at the Croydon station, including the building of the walls, and the removal and re-construction of a warehouse, are also finished. Nine thousand yards of gravel excavated in that part of the work, have been conveyed by barges down the canal, and deposited at various points on the line, ready for ballasting the road.

The construction of the railway along the level country from Croydon to Forest Hill, a distance of six miles, is a work of more than ordinary facility; the earthwork and bridges, &c. required along this portion of the line, being less considerable than usual. The first part is steadily prosecuting by small contracts, under the immediate direction of the engineer, and your Directors believe that by this mode of execution, a very considerable saving will be effected upon this portion of the works. The greater part of the locks of the Croydon Canal, descending from the summit to the bottom level, near the Deptford road, have been taken up, and the materials, consisting of bricks, timber, and ironwork, have been stacked ready for use, or already converted, under allowances from the contractors, to the purposes of the railway; 400 tons of malleable iron rails have been contracted for, and a considerable portion delivered, which are now in use by the contractor for the earthwork.

As an act of the plainest justice to Mr. Gibbs, whose forbearance has been so remarkable, under the various attacks (arising out of excitement of party) which have been made upon him in the discharge of his responsible duties to this Company, your Directors consider this to be the proper occasion to state, that they have had on all occasions, the firm reliance upon the energy and talents of the engineer, which is so absolutely necessary for the confident and steady prosecution of a public work. The Directors have now the additional satisfaction to refer the proprietors to the completion of a somewhat important portion of the works. From an inspection of them, and from an attentive examination of the plan, designs, and other details of those now in progress, or on the point of commencement, they beg to repeat to the proprietors their firm persuasion, that the character and mode of execution of the whole



undertaking, will be altogether such as to ensure to Mr. Gibbs a high degree of public reputation, to which in the opinion of others, as well of themselves, he is so fully entitled.

The proprietors will probably expect on this, as on former occasions, some remarks on the actual position and prospects of this railway.

With regard to the first point, the Directors take this opportunity to report that this Company, in deference to the opinions or prejudices of the public, has already made a somewhat considerable sacrifice in the cost of construction, by altering the gradient up to Forest Hill, from 1 in 78 to 1 in 100. Under the repeated reviews of this subject brought before them, more especially at the special assembly of proprietors, held on the 24th of January last, they have finally determined, on the grounds of economy, practicability, and experience, derived from the working of other lines of railway, steadily to prosecute their works according to the plans laid down, and to make no further alterations.

The Directors have now to inform the proprietors, that the South-Eastern Company appear to have revised their plans since the special assembly of the proprietors of this Company, their previous intention to apply to Parliament for a line of archway, leading from the Croydon Railway to St. George's Fields, is abandoned, and they appear to have finally determined that the junction between their line and the Croydon Railway shall be at Penge Common. By means, therefore, of the Croydon and Greenwich Railways, the South-Eastern Company will secure an eligible and economical approach to London Bridge, and the Croydon Company will also secure a very considerable additional traffic; the eventual amount of which, cannot, as your Directors believe, be estimated by any reference to the traffic now existing between London and the interior and coast of Kent and Sussex, with which the South-Eastern Railway will communicate.

With regard to the prospects of the Croydon Railway in connexion with a line to Brighton, the Directors are still unable to communicate any information of a positive character. There are again five parties applying to Parliament, three of whom have deposited plans for a junction with the Croydon Railway. As this Company cannot but be secure of a junction with either of the lines, and of the best portion of the traffic, if even the Western line be carried, the issue of the contest, whether successful or not to either of the parties, is now become a matter of less moment to the Croydon Company. After the lapse of another twelve months, it has become more evident, first—That the Croydon Railway, the construction of which is rapidly advancing, will offer a more direct, as well as a cheaper passage from the heart of London towards the south coast than any other line can do. Secondly—That if Parliament, as seems highly improbable, would countenance any Bill at the present time for the construction of lines of archway

from the centre or suburbs of London, capitalists are not now inclined to support any further projects of this kind. In any event, therefore, and for a lengthened period, and until an inconvenient amount of traffic on the Croydon Railway shall have fully demonstrated the public necessity of an additional line from London, your Directors are fully confirmed in the opinions which they have taken such frequent occasions to record; namely—that the Croydon Railway must of necessity be the commencement of the City line from London to the South coast; the completion of it will probably precede by four or five years, the construction of any Western line whatever from London towards Brighton, even if the Western line be sanctioned by Parliament; the cost of it will not exceed one-third of the expense of any other line; the carriage upon it can therefore be afforded cheaper than by any other, and from these causes combined with its terminus at London Bridge, it will in any event command the major part of the traffic.

Your Directors have called upon the engineer and surveyor for their revised estimates of the probable expenditure, under the head, of Land and Works, from the commencement to the completion of the undertaking; the summary of which, including the leading particulars, are as follow, viz.:—

1. Surveyor's estimate for purchase of lands and compensations, including the Croydon Canal and other purchases already made.....	£92,372	
Deduct re-sales estimated at.....	29,736	
		62,636
2. Engineer's estimate for the railway and works, in order to complete it for the passage of traffic.....	118,528	
Contingencies.....	11,852	
Stations on the line and at Croydon.....	10,000	
Locomotive engines, carriages, &c.....	10,000	
		150,380
3. Charges at the Office.....		1,984
	Total.....	£215,000

In the full belief that these estimates have been carefully framed, your Directors beg to recommend that a resolution be passed at the present meeting empowering them to raise a sum not exceeding 70,000*l.*, at such times and in such proportions as the Directors may consider to be expedient; that the said sum be raised at the discretion of the Directors, by all or any of the modes pointed out in the Company's Acts of Parliament; provided, also, that any subscription which may be proposed shall be offered first of all, and for a period to be limited at the discretion of the Directors to the holders of shares for the time being.

Adverting to the present state and progress of the works, to the

purchases of land, agreed for or on the point of completion, and to the further contracts entered into, your Directors have considered it expedient, with a view to the steady and continued prosecution of the undertaking, to make the further call of 2*l.* per share, lately advertised, and which becomes due on Saturday the 25th of March.

The actual amount of Cash and Exchequer Bills at the disposal of the Board, is as follows, viz. :—

Exchequer bills.....	£5,200	0	0
Balance in cash.....	3,439	5	6
	<hr/>		
	8,639	5	6
Add arrears of the call of 3 <i>l.</i> per share still remaining to be received on 510 shares.....	1,530	0	0
	<hr/>		
Total.....	£10,169	5	6

At the meeting of Directors, which took place on the 13th February last, the preliminary act of forfeiture was passed with respect to 849 shares, on which the last call of 3*l.* per share had not at that date been paid up. Since that time the calls and interest due have been received on 339 shares. From an inspection of the list of shares still remaining unpaid, your Directors believe that the calls will be duly paid. In the contrary case, a special assembly of proprietors will be convened, in order finally to forfeit these shares under the provisions contained in the Company's Act of Parliament.

Your Directors have finally to report, that at the ballot taken on the 13th of February last, the following Directors retired, viz. :— John Francis Maubert, Esq. and John Matthey, Esq., both being re-eligible under the provisions of the Company's Act of Parliament.

JOHN MOXON, *Chairman.*

*Dr. Statement of Receipts.*

Balance in cash, 31st July, 1836.....	£2,309	8	8
Interest on bills.....	120	16	8
Exchequer bills, sold.....	11,197	2	11
Ditto bought.....	10,040	16	8
	<hr/>		
	1,156	6	3
Call 1st on 1 share.....	5	0	0
2d on 1,151 „ .....	5,755	0	0
3d on 6,001 „ .....	18,003	0	0
Interest on calls.....	110	10	0
Fees on certificates and transfers.....	9	15	0
Stamps for transfers .....	15	0	0
Tonnage on canal .....	26	19	7
Rent on property belonging to the Company....	19	5	0
Barges, seven sold at auction.....	125	15	4
	<hr/>		
	£27,656	16	6

Stamps in hand this day.....£60

<i>Expenditure.</i>		<i>Cr.</i>
Engineering.....	£1,256	9 0
Surveying.....	381	10 0
Law.....	1,769	10 8
Land.....	3,262	0 0
Houses.....	4,265	14 0
Compensation.....	330	17 6
Barges, 36 purchased.....	2,504	0 0
Works—Sherwood.....	£4,339	19 4
Cottam and Hallen.....	1,257	16 0
Colson.....	4,528	11 6
Horses, carts, &c.....	819	0 0
	<hr/>	10,945 6 10
Salaries.....	255	0 0
Stationery and Printing.....	42	17 5
Advertisements.....	53	19 7
Rates.....	3	11 3
Petty cash.....	24	1 2
Office charges.....	91	9 6
Balance in cash, 31st January, 1837.....	2,470	9 7
	<hr/>	£27,656 16 6
Exchequer bills in hand as per last account.....	15,487	10 8
Balance as above.....	1,156	6 3
	<hr/>	£14,331 4 5

1,800*l.* of the above deposited for land, to abide the completion of Contracts.

*London, 31st January, 1837.*

*R. S. YOUNG, Secretary.*

## THAMES HAVEN COMPANY.

FIRST HALF-YEARLY REPORT OF THE DIRECTORS TO THE PROPRIETORS, 21st FEBRUARY, 1837.

THE Act of Incorporation directs that two half-yearly Meetings of the Company shall be held; one in the month of February, and the other in August.

The Directors, in now calling you together, are desirous of laying before you the balance-sheet of the Company, showing the expenditure and receipts up to this time; and it will appear, that in the present state of the finances, they would not have been justified in commencing the intended works; but they confidently hope, that when public confidence shall have been restored to mercantile transactions in general, the advantages likely to result to the commerce of this country and to the shareholders, by the construction of the Thames Haven Dock, will induce the present proprietary to come forward in a spirited manner, and lead other persons to join in providing those immediate funds which are requisite

to enable the Directors to commence the projected works, in a proper manner.

The estimate for the docks is 186,000*l.*, and for the railway to Romford 264,000*l.*; and the Directors have no reason to doubt the accuracy of the calculations on which they are founded, as they continue to entertain the highest confidence in the engineers of the Company.

The period allowed by the Act for executing the works is seven years. The engineers are of opinion that the Docks may be constructed in three years; and, as they would become immediately available for the commerce of the country at all times of tide, and under all circumstances, the Directors propose to apply the first available funds of the Company, towards that part of the undertaking.

The Directors entertain an opinion, which from the fullest inquiry seems to be general—that the very act of commencing the docks would give an increased value to the shares, by its affording a proof that it is the intention of the Company to carry this important and highly-beneficial project into effect; but they feel, that however tempting this may be, they should not do their duty to the proprietary, if they proceeded to expend the funds intrusted to their charge in their present limited state; and they have not failed to husband the resources by every attention to economy.

The Directors hope that the result of this day's Meeting will be, to give increased confidence to the public and to the shareholders; and that by an extension being granted for the payment of the call, such an amount will be received as will justify their making contracts for the works. They are therefore induced to propose, that the instalment of 2*l.* 10*s.* per share, which should have been paid before the 11th instant, may be received by the several Bankers employed by the Company, up to the 30th of April next.

*Statement for the Half-yearly General Meeting of the "Thames Haven Company," 21st February, 1837.*

To amount of receipts as per last report . . .	£15,105	15	0	
To additional shares . . . . .	15	0	0	
To additional shares paid on by land . . . . .	240	0	0	
To interest on Exchequer bills . . . . .	163	5	5	
	£15,524	0	5	
Expended, as per last report. . . . .	£9,710	6	11	
Less, by deductions on bills . . . . .	787	15	9	
	8,922	11	2	
		8,922	11	2
		6,601	9	3
By cost of Exchequer bills . . . . .		197	17	6
		6,403	11	9
To Balance . . . . .		6,403	11	9

# SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE. 321

Expended since last Report:—			
By purchase of land . . . .	2,193	17	0
By conveyance . . . . .	102	15	6
By office, printing, & stationery	211	0	11
By petty disbursements. . . .	29	18	4
	2,537	11	9
		2,537	11 9
		3,866	0 0
To amount of receipts on second instalment . . . .	2,230	0	0
To   "   "   "   "   "   paid by land	100	0	0
		6,196	0 0
Liabilities.—Oil Mill Farm Estate	5,000	0	0
"   "   Contingencies . . . .	600	0	0
	5,600	0	0

## SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

*Velocity of a River.*—Sir John Leslie has given a very simple formula for finding the mean or central velocity of a river or water-course; and he states that it is quite conformable to actual observation.\* Rule:—*Multiply the mean hydraulic depth of a river by the declivity, both in feet, and extract the square root of the product, the result diminished by 1-16th part, will be the mean velocity of the river in miles per hour.* Thus, we ascertain the rate of the majestic roll of the sacred river of the Hindoos, which has only a fall of 4 inches per mile, and a mean hydraulic depth of 30 feet, to be only about 3 miles an hour. The swelling tide of the mighty Amazon, or Maranon, for the space of 600 miles before it discharges its flood into the deep, has only a fall of  $10\frac{1}{2}$  feet,† which is about 1-5th of an inch per mile; yet, reckoning its mean hydraulic depth for that space, at 100 fathoms, it must flow into the ocean with scarcely more than the same velocity as the Ganges. For the space of 600 miles from the embouchure of this great river, the tides of the Atlantic silently oppose its lazy flow; but above this point, the declivity is about 6 inches per mile, and the mean hydraulic depth perhaps about 70 fathoms: hence, the velocity of its waters must be between 14 and 15 miles per hour, surpassing that of our swiftest steam-vessels. At this point, therefore, the opposition is dreadfully increased, and the conflict of the water is tremendous; the action of this enormous hydraulic ram of nature, produces such a revulsion in the waters of the Maranon,

\* Natural Philosophy, p. 423.

† Murray's Encyclopædia of Geography, art. 883.

that waves, rising sometimes to the height of 180 feet, roll back upon the rapid stream with the noise of a cataract, overwhelming all the banks of the Orellanic region. This phenomenon, justly called the *bore*, or by the Indians, *pororoca*, must for ever impede the useful navigation of this king of rivers.—*Practical Mechanic's Pocket Guide*.

*Lateral Draught of running Water*.—The *lateral* or rather collateral draught of water is capable of producing very splendid effects, without the aid of machinery. When a stream is carried through a reservoir or pool of stagnant water, at a lower level, it has the effect of putting the whole mass in motion; causing a great part of it to mix with the current, and thus effecting its escape. In this way, Venturi took advantage of the rapidity and lateral draught of a millrace to drain a marsh situated considerably below the stream, near the city of Modena.—*Practical Mechanic's Pocket Guide*.

*Improvement of Coffee*.—Many things have been proposed as substitutes for coffee, rye, and other grain, beans, peas, chicory, beets dried, &c., have in turn been proposed and their qualities valued. For some years past there has been sold in Paris, under the pompous name of *coffee flowers imported from America*, a dark powder, a pinch of which really communicates to coffee a very agreeable aroma, and allows of a little diminution of the quantity. I have examined this powder, and find it to be only sugar caromelized, or rather, almost completely charred. A small quantity of caromel produces precisely the same effect.

Chestnuts deprived of the envelope, cut into fragments of the size of coffee grains, dried and mixed with real coffee, roasted and ground together, are the best substitutes I have found. I have used it for thirty years. Some mix them in equal proportions.—[Bodin De La Pichounerie.]

*A Modern Mummy*.—The following story was in circulation whilst I was in Egypt, which, though I will not vouch for its "whole" truth, is not sufficiently improbable, considering the eccentric habits of my countrymen, to be altogether regarded as fiction. An English traveller had a great desire to be mummified, after the manner of ancient Egyptians; and having paid in advance to the operators bound them by a solemn oath to do his bidding, prepared his sarcophagus, and written a long notice of his life and opinions, swallowed a quantity of arsenic. He was of course "gathered to his fathers;" his body underwent the embalming process, and, the papyrus having been placed on his ambitious breast, was enclosed in the red granite case and deposited in a tomb that had been prepared for its reception. Not many years afterwards some roguish Arabs sold the precious relic to a learned Frenchman, who carried it to Paris, vain beyond belief of having acquired such a treasure, which, judging from the splendour of the case, he thought it must be a Pharaoh at least. A party of brother *savans* were invited to assist at the ceremony of unrolment, when,

after some hundred yards of fine linen had been removed, the papyrus was discovered, which in plain English, declared the great defunct to have been Mr. Peter Simpkins, of French-street and Camberwell-grove, soap-boiler and salt-refiner, to the Royal Family, and many years an inmate of St. Luke's.—*Scott's Egypt, &c.*

*Mummy Cloth.*—In the mummy pits and sepulchres of Egypt, there are such immense quantities of the ancient cloths, in which mummies were enveloped, that the article has become an object of speculation in Europe, for the use of paper manufacturers. These clothes are linen and sometimes possess great beauty and delicacy of texture. It is observed that the warp has twice or thrice, and often four times as many threads in an inch of cloth, as the woolf has. Modern weavers consider the circumstance as a proof that the ancient Egyptian weavers threw their shuttles with the hand.—*American Railroad Journal.*

*Substitute for Steam Power.*—Mr. H. Rapp, of Frankfort, has, after many years' study, succeeded in discovering a motive power, and in applying it as locomotive on railroads. This power is originally a natural power, which, by the medium of mechanism, ingeniously applied, supplies the place of steam, and offers the following advantages:—1. There is no danger of explosion. 2. The construction is not so expensive by half as that of steam-carriages. 3. That fuel is unnecessary; and 4. consequently the carriage of it. 5. That the locomotive can set out or be stopped in a moment; and, 6. Steam-carriages may be dispensed with, wherever this new invention is introduced. The inventor means to take out patents in various states of Europe.—*German Paper.*

*Electro-Magnetism.*—Mr. Braham, of Bristol, has constructed a rough model of a machine adapted as a motive power, the active principle being powerful electro-magnets. It has been in action some months, and he is now building a large model of a boat, the paddles of which are to be worked on the above principle.—*Mining Journal.*

*The "Upas" Valley, Java.*—At a late meeting of the Royal Asiatic Society, a paper was read from Colonel Sykes, on the Guibo Upas, or Porson Valley, near Betur, in Java, from a letter from Mr. London to Sir Charles Forbes, containing an account of a visit by the former on the 4th of July, 1830. Much as the fabled accounts of this celebrated valley had been disputed, it was interesting to find that they were founded in fact. The valley is in extent about 20 miles, and of considerable width, and a noxious and unpleasant smell is felt about 30 or 35 feet from the bottom. The valley presents a most desolate appearance, no vegetation existing, and the space contained numbers of skeletons of men, tigers, peacocks, &c. The former were supposed to be the remains of rebels, who, driven by the neighbouring tribes, took refuge here, where they were destroyed. One circumstance was mentioned of the head of a skeleton being supported by the right hand, in which



position he is supposed to have died. Several experiments were made by the party with dogs and fowls, which were lowered into the valley by a bamboo, in which animation was suspended, although life was prolonged in some instances to a period of ten minutes. The paper concluded with an original and interesting view of the writer, of this being the crater of a volcano, and the effects being produced by carbonic acid gas. This was referred to the action of sulphur upon water, by which sulphuric acid was produced, which action, upon calcareous matter, produced carbonic acid gas. The analogous case of the Grotto del Caul, at Naples, was also instanced.

*Durability of Wood.*—(From the "Genesee Farmer.")—The subject of the durability of different kinds of wood when exposed to the action of air and moisture, though one of great importance to the farmer and the public at large, does not seem to have received that degree of attention and elucidation it deserves. The teak tree (*tectona grandis*) of the East Indies, and the live oak (*quircus virens*) of our southern forests, appear to be nearly indestructible when employed as timber, and in naval architecture. But these from their natures cannot be cultivated in the northern states, and we must seek in our forests trees which shall approach or rival the above in excellence and durability. Fortunately these qualities are found nearly in perfection in the yellow locust (*robaiin pseudacacia*,) and the red cedar (*junipersis virginiana*,) and in a lesser degree in many others, a knowledge of the comparative durability of which, properly ascertained, would be of essential service to the public.

Thirty-two years since, in enclosing some newly-cleared fields, we had occasion to set some bar posts, and at a point where four fields cornered, we placed one so that it served for four pair of bars, one to each field. The post was the common white cedar (*cupressus thuyoides*,) cut from a thrifty tree fourteen inches in diameter, the holes on the four sides cut in the usual manner with a narrow axe, the bark stripped from the whole, and the large end set two feet in the earth, which at that place was rather moist. After standing more than twenty years, or until the basswood fences with which it was connected had rotted down, it was removed to another position, where it has since served for two pair of bars and one gate. At the time of removal it appeared quite sound, and presented appearances indicative of a duration of another twenty years at least. From our experiments we are convinced that large posts are far more durable than small ones, and that those which occupy the whole diameter of the tree, are better than sawed or quartered trees of equal size.

In the "Railroad Journal," in an article on the advantages of lime as a preservative of timber, the following instances of its effect on the durability of the White Pine (*Pinusabies*), is given. The planks were a parcel of pine planks used as a platform on the ground, on which to make live mortar. This platform was laid by

the informant's grandfather in a corner of the yard, and used every year more or less for the purpose of a mortar bed. His father continued it in the same use; himself, the grandson, continued it for a time, as long as he had occasion, after which it lay some years unused, and overgrown with grass and weeds. At length, wanting the ground for another purpose he had it torn up and removed, expecting to find the planks entirely rotted, but to his surprise found them sound, and, to use his own forcible expression, "as hard as a bull's horn." This was after they had lain exposed to all the vicissitudes of the atmosphere, and in contact with the surface of the earth, about sixty years.

In the year 1800, a Mr. Atkinson, in the employ of the Hudson's Bay Fur Company, discovered in an old factory island, in James's Bay, a branch of the Hudson's Bay, a cedar post about a foot square and five feet high, on which the following inscription had been cut, and all the letters of which were distinctly visible; "In the year 1692, wintered three ships at this island, with one hundred and twenty seven men, under the government of Captain James Knight, when we erected this monument in remembrance of it."

This furnishes the greatest instance of duration of timber set in the earth and constantly exposed to atmospheric influences we have any where noticed, and we believe there are few kinds of timber which would endure so long. This notice does not state the kind of cedar employed, but from its frequency on those islands and coasts, there can be no doubt of its being the red cedar, a kind which, as stated above, is almost imperishable.

Next to the kinds above stated, rank in durability the various kinds of pine and spruce; the white oak, chesnut, red elm, black walnut, and red beech; all furnishing timber of good quality, but not such as will, like the above, resist for a long period the attacks of time. In purchasing timber, price should not be so much regarded as quality and durability, as a rail or post that will last fifty or sixty years, is worth far more than the usual difference charged between such and those which will endure only twenty-five or thirty.

*National Maps.*—We understand in the Tithe Committee now sitting, it is in contemplation to recommend a National Survey of the whole of England, on a scale sufficiently large to set down every road, path, hedge, ditch, and boundary, throughout the country. In the Irish survey the plan is about six inches to the mile. This probably would be large enough, and if when once executed, every parish had half a dozen or more copies of the parts, including the whole parish, and were afterwards compelled at the end of every year or oftener, to lay in any alteration that had occurred, we could at all times command a most perfect plan of the whole country, with an accurate chronology of its varying features. Of what immense value would this be to the laying out of railways, canals, &c., especially if the principal levels, were also recorded on the maps. This has been done in Bavaria with great success, by the Government.

*Lunar Eclipse, April 20th.*—This eclipse presented a rather singular appearance. Though the moon was totally eclipsed and immersed in the earth's shadow nearly two-thirds of her diameter within the nearest edge of the shadow, she was never wholly invisible. On the part least immersed, she appeared to the naked eye like a number of small reddish stars.

*A New Lamp.*—On the 3d of April, M. Duverger exhibited a new lamp at the Adelaide Gallery, to a large party of scientific gentlemen. The performance of the lamp was very satisfactory. It is calculated to burn about six hours; but we are not aware that it will be more economical, or any way superior to the common argand lamp.

*Light under Water.*—Mr. Maugham, lecturer at the Adelaide Gallery, has made a very ingenious application of the galvanic spark, for a light under water. The light is exceedingly brilliant and intense, and wherever it can be used will be a great acquisition to subaqueous researches.

*The American Locomotive, the George Washington.*—"Diameter of the cylinder,  $10\frac{1}{4}$  inches; length of the stroke,  $17\frac{1}{2}$  inches; number of tubes, 78; outside diameter, 2 inches; length, 7 feet; diameter of the driving-wheels, 4 feet; diameter of the truck, 30 inches. The engine is six-wheeled, having two driving-wheels. Whole weight of the engine, 14,930lbs." (6 tons  $15\frac{1}{2}$  cwt.), "actual weight of the driving wheels, 8,700lbs." (3 tons  $17\frac{1}{2}$  cwt.)

This engine is reported in the "American Railroad Journal" to have taken, including itself, a load of 31,270lbs. or nearly 14 tons up a plane 2,800 feet long, rising 369 feet per mile in two minutes twenty-four seconds, and with a velocity continually increasing, having started on the plane, the steam-pressure being 80lbs. to the inch. Now, according to our experiments, and any we have yet heard of in England under ordinary circumstances, this is utterly impossible. The whole weight which the adhesion of the 8,700lbs. on the driving-wheels could take up the incline of 369 feet to the mile, would be under 12,000lbs., or little more than one-third of what the American engine is said to have done. It is true the rails were said to have been sanded at the bottom, but we do not think it possible a little sand thrown on one point could have had such an extraordinary effect the whole way up; and we are therefore inclined to believe there must be some error or something amiss in the statement.

*Tendency of Vegetables to approach or fly from the Light.*—M. Dutrochet has been occupying himself with this very curious subject. Of vegetables which incline towards or approach the light, it has been generally supposed that it arises from an elongation of the parts on the opposite or darker side; the above philosopher, however, from a very simple experiment, has proved that it arises from a contraction of the side towards the light, the opposite side being perfectly neutral. He took a young stem of lucerne very much bent towards the light, and having cleft it down so as to separate

the light from the dark side, he found the light side become much more incurvated while the other redressed itself. Again, he did the same with a stem of ivy, which is one of the plants inclining towards the dark, and he found the dark side bent considerably more after the cleft, whilst the other not only redressed itself, but bent slightly in the opposite direction. He finds the cause and whole difference of the two species, as might be expected, to arise from a difference in the structure of the barks or rinds of the plants, and from the influence of light on vegetable transpiration, and that the phenomena are altogether mechanical, and have nothing of animal instinct, as some have supposed.

*Extremely low Temperature in the Solidification of Carbonic Acid Gas.*—M. Pouillet has lately determined the temperature of carbonic acid gas, when solidified by means of an air-thermometer, magnetic-thermometer, and an alcohol-thermometer, and finds a singular coincidence in the results. They all make it very nearly  $78\frac{3}{4}^{\circ}$  of centigrade or  $141\frac{3}{4}^{\circ}$  Fahr. below the freezing point. This cold is about  $20^{\circ}$  lower than has been before produced. It appears from these experiments that a thermometer made of pure spirits of wine goes on, *pari passu*, with an air-thermometer, to about  $143^{\circ}$  of Fahr. below the melting of ice.

*Vesuvius an emerged Volcano.*—Several shells of the following kinds have lately been found on Mount Vesuvius, namely, *terri-tella terebra*, *cardium ciliare*, *corbula gibba*, and part of the *echinus marinus* not entire, from which it is inferred that Vesuvius is a volcano emerged from the sea.

*Telegraphic Communications by Galvanic Electricity.*—Two gentlemen are employed in experiments on this subject, and anticipate complete success. The apparatus will be applied, if successful, wherever lines of railway are laid. If the method succeeds, it is expected we shall be able to communicate with almost any extremity of the kingdom to which railways extend in about three minutes.

*Van Mons's Method of raising Fruit-trees from the Seed.*—(Concluded from page 268.)—We close this article with an account of the severe disappointments which this distinguished man has been doomed to experience of late years. While pursuing his experiments on a very extensive scale, in his nursery at Brussels, in 1819, the ground, which was occupied by his vast collection of new fruits, was declared to be indispensable for streets and building lots, and he was summoned to vacate it in the short space of two months, under the penalty of seeing all his trees cut down and thrown into the fire. As professor of the University of Louvain, he resolved to remove his nursery to that city, that it might be more completely under his control, but the period assigned for evacuating his nursery was, unfortunately, in the winter. His loss was consequently great and irreparable; and being obliged to confide nearly the whole care and labour of removal to others, it was with great difficulty he saved a twentieth part of his nursery. After his removal to Louvain—with the exception of having a great number of young plants broken down and drawn out of the ground, by the masses

of ice which were left upon it after a great freshet in the river which passes through the city, and which overflowed his nursery to the depth of seven or eight feet,—he enjoyed more or less quietly this new location during the following thirteen years. His correspondence was renewed and extended, his losses were replaced by new acquisitions, and the mass of his observations was augmented, and his new varieties were liberally disseminated. “But,” observes Poiteau, “*public utilite* had sworn that she would finally embitter his old age. In 1831 we besieged the citadel D’Anvers, and although Mr. Van Mons’ nursery was fourteen leagues distant from the army, the engineers could not find a more commodious place than that nursery to bake the bread of the soldiers in; consequently, a great part of his trees were destroyed, having constructed their ovens on the ground where they grew, and the fruit of the others was exposed to pillage.

“Still the philosophy of Mr. Van Mons sustained him in this unexpected devastation; he hired two other tracts of land into which he removed his young plants; he was consoled because he had time to collect, although it was summer, scions of the trees which were sacrificed to afford a place for the erection of ovens; but *public utility* had not yet exhausted all her severities against him. Unfortunately, there was not a chaplain in the council of the prince, and the engineer, seeing nothing decided, again in 1835, in the name of *public utility* that Mr. Van Mons’ nursery was the sole and only point on the globe, proper for establishing a gas-house for lighting the city. Heaven grant that these gentlemen may be enabled to see better for the future; but it is not in their power to prevent the true friends of intellectual light, and of public prosperity from regarding their decision as an act of ignorance and the grossest vandalism.

“Mr. Van Mons is actually seventy years of age; he has consecrated his whole, all his life, a large part of his fortune, to public utility, and yet it is in the name of *public utility* that they have slain him, assassinated him. O age of light, how dark thou art!

“In the commencement of September, 1834, Mr. Van Mons, on sending me a box of pears, which were the first of a seventh generation, observed in his letter, ‘when you taste these pears, the tree which bore them will no longer exist.’ In fact, I learned a few days after, that the destructive axe had prostrated these trees and many others, that the nursery was dishonoured, lost, and Mr. Van Mons frustrated in his dearest hopes, which were to send us the products of his labour.

“It is impossible to foresee, or rather I dare not express my fears, as to what will become of the ruins of an establishment, which wanted encouragement, which was of a nature to elevate the glory of an empire.”

A note is added, stating that he had been ordered to evacuate the whole of the land before the end of February.

## RAILWAY NOTICES.

*Anti-dry Rot.*—It will be seen by the article in this number of the Magazine, on the Midland Counties Railway, that Mr. Vignoles the engineer is going to use his timbers prepared after Kyan's patent. Mr. Brunel is doing the same on the Great Western. We are glad to find this from two such distinguished members of their profession, because it stamps a character on an invention of which we have always thought highly.

*Birmingham Railway.*—This Company has no less than 3,000 men employed on the extension only from Camden Town to Euston-square, that is, about  $1\frac{1}{4}$  mile. The daily wages of these men amount to 600*l.*, or at the rate of 180,000*l.* per annum. We think this looks like earnest and business. The works are executed, we are informed, for we have not seen them, in a very masterly and substantial manner.

*Birmingham, Bristol, and Thames Junction Railway.*—The works of this railway are advancing with steadiness, and the embankment across Wormholt Scrubbs is rapidly proceeding. We are glad to find that both the Great Western and the Birmingham Railway Companies are co-operating with this Company in the formation of their line.

*Brighton Lines.*—Tuesday, April 25, the Committee have this day decided, by a majority of twenty-six to seventeen, that Stevenson's line is circuitous and unfit for a direct railway communication to Brighton, and have adjourned until Friday the 28th, to give the other parties an opportunity of making an amicable arrangement. We shall be glad to hear that they have; and we think it would have been very wise if the Committee had done this long before, and not have permitted the Companies to squander so much money for no possible good. We expect we shall be out before any division is come to, but we cordially advocate the plan of an amicable understanding. Why should not all the Companies submit their plans to two or three competent persons, and take the best, letting all the engineers, subscribers, &c., &c., jointly participate in that one? It might be easily done, and we are quite sure it would be the fairest and most beneficial way for all.

*Central Kent Railway.*—We have just seen copies of the plans and sections of this line, as revised and deposited, by the Messrs. Rennie, for the ensuing session. They contain no gradient above 17 feet a mile and that for a short length; and the previous objectionable curves are taken away. Neither is there any tunnel on the whole line, nor apparently any difficult work, except in crossing the rivers Darent, Cray, and Medway. The line is certainly very much improved, and reflects great credit on the skill and assiduity of the engineers, by whom an able report of it has been drawn up.

*Clarence Railway—Byer's-green Branch.*—This branch line of railway, which connects the Clarence with the coal-fields of south and west Durham, was opened on Friday, the 31st of March, for the transit of coals and merchandise, and is expected to prove a valuable source of income to the Clarence Railway. The Byer's-green Branch Railway is a locomotive line, five miles in length, and was commenced in October last. Taking into consideration the heavy cuttings and embankments required, combined with the past unfavourable season, its early completion may be regarded as an extraordinary instance of despatch, in railway making.—*Mining Journal*.

*Cork and Passage Railway.*—This Bill passed the Committee, after a brisk opposition, April 26.

*Eastern Counties Railway.*—We have at length goaded the ruler of this Company to make a *show* of doing something more than living in "fat contented idleness" on the money the shareholders have subscribed. It is pompously advertised that the works "of this important undertaking are in *full progress*." From another quarter we learn that 500 men are employed. Supposing this to be literally true, it would make, the line being 126 miles long, not quite four men to a mile, if spread over the line,—a very peaceable distance indeed for them. Why, it is hardly a man to three acres of the land the Company proposed to take, and therefore about half enough to keep the weeds down in summer. Not long since the Birmingham Company employed between 10,000 and 11,000 men on the line alone of 112 miles, and they have now 3,000, on  $1\frac{1}{4}$  miles. The Eastern Counties have not a twentieth of the former number, or more than  $\frac{1}{8}$  of the latter, on a line 14 miles longer, and yet publish that the works are "in *full progress*!" Can this advertisement have proceeded seriously from men of business? or is it another unlucky fruit of Mr. Robertson's scribbling propensity? In his far-famed correspondence with Lord Petre (see our preceding two Nos.), he contrived to get the honour, and even the conduct and veracity, of his Directors most sadly singed, but now it would seem their common sense and knowledge of what they have to do in the matter they have undertaken, are not to escape. Is it for these scribbling exploits he is paid a salary of 800*l.* per annum (he modestly wanted 1,200*l.*, we hear), with permission to continue the editor of a little threepenny weekly publication, and to follow the business besides of a patent agent? Eight hundred a-year for a mere fraction of this man's time, that is several hundreds more than any other secretary we know of has for the *whole of his* time, argues a very flourishing state of the Company's affairs, or singular liberality on the part of the Directors. We know something of periodical labour, and we think a weekly publication would pretty fully occupy the time of any man, it used to of Mr. Robertson, to say nothing of the patent agency.

Query:—How much, or rather how little labour is to be done for this 800*l.* a-year? or if there is much, how is it done?

There is one part of the advertisement we much admire, namely, that which puts off *sine die* another call for more money. We think this very prudent and very sensible. But we hope they will not advertise again soon, it so interrupts our more serious inquiries. For instance, it has now delayed for some minutes the following interesting account of the financial situation:—

<i>Assets.</i>	<i>£.</i>	<i>Liabilities and Payments.</i>	<i>£.</i>
Cash received on 60,000 shares	60,000	Expenses of Act, &c. . . .	35,562
Ditto Call, about . . . .	50,000	Ditto since, about. . . . .	6,000
Deficiency of Assets to meet		Bond, &c., to Lord Petre . .	120,000
demands without doing any-			
thing . . . . .	51,562		
	<hr/> £161,562 <hr/>		<hr/> £161,562 <hr/>

Thus, if the Company's liabilities were discharged, they are now some 51,000*l.* in debt, with "splendid offices" (see last No., p. 273), about 6,400*l.* (as nearly as we can estimate it) per annum expenses, exclusive of the 500 mens' labour, and yet they have *no need of another call!* What could Lord Petre say to this, except that the advertisement contains "assertions, not facts?"

*Fleetwood Town and Port.*—Too much cannot be said in advocating the opening of a commercial seaport on the coast of Lancashire, for which great praise is due to the Honourable Member for Preston, Mr. Hesketh Fleetwood, who has not only advanced large sums of money to accomplish the important object, but has been indefatigable in promoting it. Apart from the advantages it possesses by its locality, the harbour (decidedly the best on the coast), is not only capable of becoming a port of extensive commercial utility, but also one of refuge, so long a desideratum on that part of the coast. Its proximity to the principal ports in Ireland, enjoying as it will, rapid communication with those ports by means of steam-ships, and whence all the northern districts of the country secure their supplies of grain, cattle, and provisions, and its nearness to the flourishing town of Preston, having a population of upwards of 400,000, with its railway now fast approaching completion, will be great advantages. Thus for the transit both of passengers and merchandise, it will become not only the cheapest, but nearest and best for all parts of the country, without the risk of passing up rivers, encumbered with dangerous sands, and varying channels, while the Wyre opens the means of safe and easy access, and in less than half an hour after entering its waters, the passenger will find himself on the delightful spot where the town of Fleetwood is now rising, under the generous auspices of the proprietor of the land.

*Grand Junction Railway.*—On Monday week the Directors made an inspection, from which it appears, that there are sixty-



four miles of the line actually finished, ten of which only require the rails to be laid, and four where the earth-work is still in progress, and will be completed in six weeks, at farthest; so that there can be no doubt the original promise of the Directors will be kept, and the line opened this summer, when the communication between Birmingham, Liverpool, and Manchester will be complete. Between Barford and Wharton, eleven miles are completed with double rails. The great viaducts over the Weaver at Dutton and Harford, are completed all but the parapets and approaches. The part between Penkridge and Birmingham is less forward, but still in a very satisfactory state. The bridges and viaduct into Birmingham are nearly or altogether finished, and the least advanced parts may be expected to be completed within the time specified.

*Great North of England Railway.*—We regret to observe, that the Merchants' Company of York have resolved to petition against this Company's Bill, because they propose to take power by it to cross the river Ouse by a bridge at Nether Poppleton, four miles above York. We hope some plan may be suggested to meet the views of both parties, for the railway itself is an undertaking of so much importance to the public, that we should be exceedingly sorry to see it thwarted in a manner which affects its prosperity or usefulness.—*Tyne Mercury.*

*Great Western Railway.*—The works of this line are proceeding very vigorously. We hear that Mr. Brunel, sen., the father of the engineer, has lent some of his most expert men to facilitate the execution of the Box Hill tunnel, which progresses very rapidly.

*Harwich Railway.*—It is reported that this line was withdrawn from Parliament, in consequence of the Eastern Counties Line, to which it is a branch, "existing but with very slender hopes of success." Why do not the Harwich Company boldly bring their line on to London? We have no doubt the measure would be highly pleasing, and well supported. The sickly parent might then lean on, and become a branch to, its robust offspring.

*Kent Railway.*—After a most torturing suspense of thirty-seven days from the close of the inquiry, the report has been presented (the 24th) to the House, but will not be taken into consideration until too late for the present number. We understand it consists of about twenty-two printed folio pages. Is this to be paid for by its length? We congratulate the Company upon getting out of this Committee at all, which has not been inaptly called "Warburton's Railway Chancery."

*Kent Report.*—We have had a glimpse of this report, and shall not overlook it in our next. We have noticed some droll statements in it; one in particular in curious collision with the evidence given.

*Leeds and Manchester Railway.*—We understand that the owners of property in this district have received notice to clear

their portion of land through which the intended line will pass, and that the operations will commence early next month.—*Halifax Guardian*.

*Locomotive Power*.—One of the locomotives on the Newcastle and Carlisle Railway, the Goliah (George Mann, engineer), brought down from Kirkhouse, sixty-three waggons of coal in one train, each waggon weighing, with coals, about four tons and a quarter! With this immense load (267 tons), she travelled the distance, twelve miles, in less than forty minutes.—*Carlisle Journal*.

*The Maunch Chink Coal-mine* produce in Pennsylvania, is conveyed to a village of the same name in waggons, running on an inclined railway; and to each train of forty-two waggons there are seven cars attached, containing twenty-eight mules, which are employed to draw back the waggons when emptied. Professor Silliman states, that the mules readily performed their duty of drawing up the empty waggons; but, that having once experienced the comfort of riding down, they appear to regard it as a right, and neither mild nor severe measures, not even the sharpest whipping, can ever induce them to descend in any other way.

*Sheffield and Manchester Railway*.—This most important measure has passed its principal stages in Parliament, having been read a third time in the House of Lords, establishing itself as an eligible mode of transit over the back bone of the island, and exhibiting tables of traffic most satisfactory to the shareholders. Attempts have been made to depreciate this railway, and not the least bold were those of the South Union Railway Company, which, finding it likely to be a competing line, endeavoured to decry the plan. The fact is, that the Sheffield line to Manchester from Lincoln, Gainsbro', and the surrounding districts, is above twenty-five miles nearer than the South Union projected line; and the futile attempt to disparage the Sheffield and Manchester Railway has ended in the exclusion of the South Union Railway from the line which they projected from Stone to Tamworth, thereby necessarily throwing the traffic both in goods and passengers upon the North Midland, and from thence on the Sheffield line to Manchester; an additional traffic in goods, ascertained to be at least 1,400 tons per week, besides passengers, by this means will be brought upon the Manchester and Sheffield Railway. We believe the South Union and Cheshire Junction Companies are uniting to form but one Company. The South Union not being allowed to proceed further than Stone, it is a matter of little consequence which of the two lines is ultimately adopted by the united Company. The expense incurred by these two Companies has been enormous. We think the Committee of the House of Commons have done wisely in insisting upon a union between the two. We understand that a contract has been entered into by the Sheffield and Manchester Company with the South Union

and Cheshire Junction, whereby the carriages of the former are to run upon the line of the latter from Chancery-lane to Shore-street, in Manchester, a distance of about three quarters of a mile, on very advantageous terms. The railway from Chancery-lane to Shore-street, was by far the most expensive part of Mr. Vignole's line from Sheffield to Manchester, being in the town of Manchester. There is every probability that this railway will be executed for the proposed capital, 700,000*l.*—*Sheffield Mercury.*

*New Description of Railroad.*—A patent for ten years has just been granted by the Emperor of Russia to one of his Aides-de-camp, for the invention of a new species of road, which it is calculated will excel all others. The plan is to place the wheels (mere friction rollers), not upon the carriages, but upon the rails of the road itself, and to have it travelled over by sledges, drawn by horses. The experiment has been tried in the neighbourhood of St. Petersburg, and it is said that a horse can gallop at the top of his speed, and draw a great load after him.—*Frankfort Paper.*

*Newcastle and Carlisle Railway.*—The annual general meeting of this Company was held in this town on Tuesday last, and was most numerously attended, showing the increased interest taken in the concern. A very favourable report was read from the Managing Committee. They stated that the works were all in excellent order, and had stood the wear and tear remarkably well. The engines they also stated to be in good working condition, although those in use at the east end had been constantly at work for two years. The revenue was increasing, and every thing tended to hold out the most flattering signs of prosperity. It was also resolved to prosecute that portion of the road which yet remains unfinished with the utmost possible despatch, and an agreement has been entered into with the contractors to have the work finished by January next. It was also resolved to construct a bridge across the Tyne at the most convenient point below Blaydon, to carry the railway to Westgate-street, and thus obviate the objection of the present termination. The present termination at Gateshead will remain for heavy goods, and to join the Brandling Railway to South Shields and Sunderland; whilst that which it has now been resolved to form will be used for passengers—thus carrying them into the high part of the town. The "*Carlisle Journal*" says, "When the work is finished, no doubt is entertained that the passenger-trains will accomplish the journey from Carlisle to Newcastle in two hours and a half, and as a proof that this is not an over-sanguine view of the matter, we may mention that the Directors who attended the meeting from this city were conveyed in the midst of a snow-storm, on Tuesday last, by the Eden locomotive engine from the London-road station in fifty minutes, and from Haydon Bridge to Gateshead, by the Tyne locomotive, in an hour, thus accomplishing forty-eight miles in one hour and fifty minutes. The two engines we have named

were recently built for passenger-trains, and answer their purpose admirably."—*Tyne Mercury*.

*River Tyne*.—Mr. Cubitt, the engineer, has just completed a survey of this river, for the purpose of suggesting the best means of widening the harbour, and letting in a greater quantity of the tidal water. In consequence of his recommendation a dredging-machine is constructing.—*Tyne Mercury*.

*Standing Order Committee*.—In consequence of the numerous railways Bills that have been forwarded to the House of Lords, and the new standing orders recently adopted concerning all such measures, their Lordships have appointed a very useful "Standing Order Committee," for the purpose of specially considering all such Bills, and of reporting whether the standing orders have been complied with.—*Mining Journal*.

*Victoria Bridge*.—Mr. Dredge has secured an English and Scotch patent for the Suspension Chain, which is likely to establish an entirely new system in bridge building. We understand that the advantage, as compared with the Menai Bridge, which cost 120,000*l.*, is the enormous saving of money, inasmuch as, on his plan, one twentieth part of the iron would have been sufficient, and would not only give a greater security to the structure, but effect a saving in the outlay of near 100,000*l.*—*Mining Journal*.

*Petitioning Club*.—It came out in evidence on the 24th ult., that some jobbers on the Exchange had formed themselves into a club for the purpose of petitioning against railway companies, from which they expected to reap a good harvest. Will the Legislature sanction this? Will Honourable Members permit their time to be wasted by the hour, day, and week, to hear the inventions and fill the pockets of such men? We shall see. If Honourable Members would satisfy themselves of the respectability of petitioners—which we think is due to their own characters and that of the House—before they presented their petitions, it would put the extinguisher on all not from such sources as it would not degrade the House to listen to. We are as anxious as any one to crush the system that has been going on; but is it not the standing orders which have been the sole cause of it? If that foolish order respecting the amount to be subscribed had not existed, there would have been none of this fraudulent paid-for subscribing. Let parties bring their lines to a competent test of their merits. If they have not prudence enough to provide funds for passing the ordeal, that is their fault, and let them pay the penalty by a loss of their line midway. If they have, and it is decided to be a good one, there will be no lack of subscriptions after the Act is obtained. As to a protection to the public, the standing orders are not nor can they ever be made any protection at all; but they hold out excellent encouragements to commit fraud and perjury. A much better, and for the public safer, standing order would be, to make, of individuals concerned in railway com-

panies, TRUTH NO LIBEL. We should soon, then, rid ourselves of bubble concerns, and purify some others of the swindlers that are in them.

*Vienna and Milan Railway.*—An intelligent correspondent in the "Chester Gazette," alluding to our notice of a railway under the above title, in our last, taken from a foreign paper, observes, that he thinks it contains a typographical error, and should be read *Venice and Milan*. "The distance between Vienna and Milan is between 400 and 500 miles, traversing a vast rocky and mountainous district," while between Venice and Milan it is only "about 140 or 150 miles," which might well be travelled in the time specified—six hours. This gentleman, who seems to be well acquainted with the country, makes the following interesting remarks:—"I now approach another division of my subject, which is to recommend a continuance of the above railway to Genoa by Pavia. The distance is about 100 miles, for the most part passing through a rich and luxuriant plain, and it would never be so formidable an undertaking as the Manchester and Leeds, or Manchester and Sheffield lines. Let us now contemplate the advantages to be derived from as practical a railway as was ever devised. We shall have railway communication from the Adriatic to the Mediterranean, transporting to and fro the produce of various climes, meeting at Milan, a rapidly-improving city, passing through a country abounding in silk, wine, oil, &c., and having as a *terminus* two venerable and renowned cities, now, alas! sunk into a lethargic slumber, from which the hissing engine and busy hum of commerce would arouse and regenerate; restoring them to their pristine rank in the scale of nations."

*American Railroads.—Watertown to Rome.*—A line between these places, about 76 miles 45 chains, has been surveyed by Mr. Dewey, who reports that the total cost will be 494,616 dollars, averaging 6,460 dollars a-mile, exclusive of nine turn-outs, station-houses, and other appendages.

*Watertown and Cape Vincent.*—The above engineer has reported that this line will cost in construction 145,966 dollars, or 5,782 dollars per mile. The distance is nearly 25 miles.

The following are the concluding remarks of the American engineer, Mr. Wm. Dewey, in his report on the above railroad. Either we are sadly in the dark as to the capabilities of locomotives, and most wantonly waste our money in the reduction of the difficulties of a country, or our transatlantic brethren have better means of managing locomotives than we have:—

"In an engineering aspect, the advantages presented by your road are—Its cost will be much below the average per mileage expenditure for similar works—its grades at no point exceeding a rise of 1 in 160, or 33 feet per mile, are such as can be surmounted by locomotives; with heavy loads, with much ease, and great rapidity; its departure from a straight line will not require, in the

most confined locality, a less radius than 2,000 feet (not half a mile) while in most cases, they can be projected from radii of 5,000 or 6,000 feet."

Railroads are in contemplation from Free Port, in Butter county, through Butter to New Castle; from Jefferson, through the mineral region in Washington county, to some point on the Mississippi, in South Missouri; from Auburn to Rochester.

*Expedition of American Engineers.*—Such is the industry and rapidity of construction of railroads in America, that 28½ miles of the Tuscumbia, Courtland, and Decatur Railroad were begun and finished in little more than nine months.

*Railroads in the United States.*—*Philadelphia, February 24.*—In the United States, the experiments of railways have been amply tried, and found by experience to have done the work of centuries in a few years towards advancing the arts, manufactures, trade, and civilization of the country. Most of them have paid enormous profits to shareholders, and infused a rapid circulation of the blood into the industry and enterprize of the republic, that is not a little surprising to foreigners. The boasted Napoleon road across the Alps, had the Alps been in America, would have been accomplished in an incredibly short space of time by railway; and, great as that work is, it does not in my opinion transcend the canal and railroad from Philadelphia to Pittsburgh (392 miles) across the Apathachian, or Alleghany mountains. But even this great work is light in comparison with the projected railroad from Charlestown (South Carolina) to Cincinnati (Ohio), by way of Knoxville, (Tennessee). This gigantic undertaking will be 715 miles in length, and cross the lowest ridges of the mountains amongst the Smoky, Greenriver, and part of the Bluebridge and Cumberland mountains—a vast region, in most parts from 1,200 to 2,000 feet perpendicular from the sea. The above railroad includes a branch to Louisville, of 75 miles. An immense number of shares are subscribed for, enough to insure the progress of the work. The ground has been surveyed already, and the Legislature of South Carolina has granted the Company banking privileges, and all this within the last nine months. You will be aware of the advantages derived in the way of expeditious travelling in this country, when I inform you that, from Boston to Washington, through New York, Philadelphia, and Baltimore, near 470 miles, may be performed by starting early in the morning from Boston and arriving late on the following night at Washington. The entire route is travelled by steam on river, sea, and railway, and the expense is trifling. Fifteen years ago this very journey would have been almost as serious as a voyage to Europe.—*Morning Chronicle.*

*First Russian Railroad.*—We have before us the translation of a pamphlet with the above title, showing several particulars and

facts relative to the first railroad, the Zarsko-Selo, that has been made in Russia. The moment the Emperor heard of railroads he gave them every encouragement by granting extraordinary privileges, &c. Indeed he has displayed a sagacity and attention to the interests of his country that do him high honour. "The execution of the railroad is regarded, as if undertaken immediately by the crown, and the crown lands have been gratuitously ceded to the Company." "To prevent the obstruction of the works, the Company, by depositing a sum of money about equal to the purchase price of a similar plot of ground in the vicinity, have the power to take possession before the termination of the appraisement, and when this is done the balance either way is paid over." "The Company are not bound to any fixed charges for passengers or goods, and the property of the line remains for ever in the Company." Mr. Von Gertsner, the engineer, we see, adopts the minimum breadth we had fixed on as the best for the rails, namely, six feet. It is remarkable that Mr. Brunel adopts our maximum, seven feet, and Mr. Von Gertsner the minimum.

"Each locomotive" used on this railroad "has six wheels, of which, the middle or driving wheels are six feet diameter; the weight of the locomotive is 270 cwt." or  $13\frac{1}{2}$  tons, and of an empty tender 93 cwt.; an empty half-open carriage with 24 seats, weighs 78 cwt.; an empty coach with 30 seats, 68 cwt.; and an open waggon with 40 seats, 47 cwt. The whole weight of a train, with about 350 passengers, is about 1,600 cwt.

The length of this line is sixteen English miles, and will be finished in July this year. It is then intended to continue it on to Moscow, an additional distance of 390 miles, which will make the longest line of railroad in Europe, and we have no doubt, from the immense traffic existing on that line, the grand thoroughfare of the colossal dominions of the Emperor, will be one of the most profitable. Von Gertsner himself, we perceive, has offered to farm the Zarsko-Selo line for ten years, when finished, to pay the rent quarterly, and three months in advance. He undertakes to keep the whole line, &c. in perfect repair, and to pay a rent the first year of 9 per cent., the second of 10, the third of 11 per cent. on the whole capital, and 8 per cent. per annum besides on the invoice cost of all locomotives and carriages, exclusive of his repairs. This looks like confidence and good profits for the shareholders.

*Continental Railways.*—The French and Belgian Governments have at length decided on the formation of a railway between Paris and Brussels. Mr. Cockerill, the extensive iron-master at Liege, is at the head of the association to whom the *concession* has been granted for carrying into execution this great undertaking.

The line adopted is by Amiens, Lille, and Ghent, and from Lille a branch is to be carried to Calais, which will connect the northern coast of France, both with Paris and Brussels.

# **PARLIAMENTARY PROCEEDINGS.**

## **HOUSE OF COMMONS.**

Progress of Bills since our last, any omissions in which are here inserted.—Ardrossan and Johnstone, read 2nd time, April 7. Belfast and Hollywood, 2nd time, April 21. Birmingham and Derby, 1st and 2nd time, April 14 and 24. Birmingham and Gloucester, 3rd time, April 5. Brighton, Lewes, and Newhaven, 1st and 2nd time, Feb. 13 and 21. Chester and Crewe, reported April 14, read 3rd time April 26. Clarence (Durham), reported March 17, read 3rd time April 14. Clarence and Hartlepool (Great North of England), 2nd time, April 17. Commercial (London and Blackwall), 1st and 2nd time, Feb. 16 and 24. Cork and Passage, 2nd time, March 22, got through Committee, April 26. Dublin and Drogheda, 2nd time, April 5. Durham Junction, 2nd time, April 19. Durham and Sunderland, reported April 10, read 3rd time, April 21. Exeter and Falmouth, passed Committee April 26. Grand Connexion (Worcester and Wolverhampton), reported April 26. Great North of England (Castle Eden), reported April 12. Lancaster and Preston, 3rd time, April 6. Leicester and Swannington, reported April 24. London and Birmingham, reported April 10, read 3rd time, April 19. London and Greenwich, reported April 4, read 3rd time, April 19. London and Southampton, 3rd time, April 5. Manchester South Union, 1st time, Feb. 15, 2nd time, Feb. 24. Manchester and Leeds, 1st time, Feb. 14, 2nd time, Feb. 22, reported March 20, read 3rd time, April 5. Manchester, Bolton, and Bury Canal Navigation and Railway, 2nd time, April 4. Manchester, Cheshire, and Staffordshire, 2nd time, March 6. Maryport and Carlisle, reported April 24. North Midland (Leeds and Derby), 1st time, Feb. 15, 2nd time, Feb. 24, reported March 17, read 3rd time, April 5. Oxford and Great Western, 3rd time, April 5. Polloc and Govan, 2nd time, April 4th. Preston and Wyre, 3rd time, April 5. Sheffield and Manchester, 3rd time, April 5. Slamannan, reported April 21. South-Eastern (Ashford and Canterbury), 1st time, March 13. South-Eastern (London and Dover), reported March 16, read 3rd time, April 5. Southwark and Hammersmith, 1st time, Feb. 15, 2nd time, Feb. 24. Taff Vale (Merthyr Tydfil), read 3rd time, April 5th. North Midland, reported April 17.

*April 4.*—Mr. T. Duncombe presented a petition from Richard Lill, to withdraw the one he had previously presented against the City and Richmond, or Southwark and Hammersmith. Permission not granted.

*April 6.*—The inquiry respecting the alteration of the title of the City and Richmond Railway to that of the Southwark and Hammersmith, was referred to a Select Committee, which subsequently reported, that the alteration had been made by the Committee, and not by the Directors, nor with their knowledge.



*April 12.*—Mr. Miles moved the second reading of the Bath and Weymouth Bill; Mr. Roebuck, as an amendment, that it be read a second time that day fortnight, and referred to a Committee in the meanwhile, to inquire into allegations of incompetent subscribers to the deed, which was carried.

*April 13.*—Mr. Mills's (engineer to the "Brighton line without a tunnel") petition, accusing Stevenson's of having passed the standing orders by fraudulent representations, was warmly discussed. Debate was adjourned to Monday, the 17th, when Lord G. Lennox, on behalf of Stevenson's Committee, denied some of the allegations in Mills's petition. After a sharp discussion, a motion for referring the matter to a Select Committee, was chiefly on the ground of not establishing such a precedent so long after the event.

Lord G. Lennox presented a petition from Mr. Till, secretary to Stevenson's line, alleging fraudulent signatures to the deed for Rennie's line; also a petition from Benjamin Wheeler Poulton, a stock-jobber, and one of the petitioning club, admitting that he had signed it for *1l*. Captain Alsager presented a petition from Rennie's Committee, totally denying Mr. Till and Poulton's allegations.

In the Westminster Bridge and Greenwich Railway deed, it has been alleged by the notorious Poulton, and proved by Chamberlain and Jacobs, two other stock-jobbers, we believe, that the latter procured signatures to the deed by needy persons for 10s. a-head, at the instigation of Mr. William Gibbs, brother to the engineer; and that the signatures were affixed at Mr. Gibbs's office in Bucklersbury. It has, however, been shown, that the Company were ignorant of it collectively and individually, and that without these signatures the deed had been amply and most respectably signed. Mr. Gibbs subsequently came forward, and gave evidence, stating, that Mr. Price, the Company's engineer, had urged him to invest largely in the undertaking as a good speculation; that he took 1005 shares, and fearful to subscribe for so great an amount, got the several persons to sign for him; and that he distributed the shares among his friends, on all of which the deposits have been paid.

On the evidence of Chamberlain it appeared, that Poulton and Green were promoters of bubble companies; adding that he had heard them on 'Change declare their intention to get up petitions against railway companies, by which they hoped to make plenty of money. Will the House in future suffer itself to be insulted with petitions from such quarters? It is quite evident that money has been paid for signing deeds; but we hope the House will now do away with that silly standing order which has in effect held out a premium for it.

*April 26.*—Lord G. Lennox moved to refer Mr. Till's petition relative to Sir J. Rennie's deed to Warburton's Committee, which with much opposition was agreed to. This is strange after

the fate of Mills's petition. We were glad to hear Mr. Duncombe declare it would be trifling with the House to proceed further on statements coming from such a quarter as Poulton.

HOUSE OF LORDS.

April 21.—Lord Wharncliffe moved the second reading of the Oxford and Great Western Union Bill, which, with some debating, was carried. Lord Brougham hoped to see the time when these matters would be withdrawn altogether from Parliamentary jurisdiction. We sincerely hope so too, and have always urged it.

Progress of Bills.—Birmingham and Gloucester, read 1st, 2d, and 3d time, April 6, 14, and 21, and waits Commission. Clarence (Durham), 1st and 2d time, April 14 and 21. Great Western (Paddington), 1st and 2d time, April 6 and 18. Ditto (Trowbridge), 1st and 2d time, March 22 and April 21. Lancaster and Preston, 1st, 2d, and 3d time, April 6, 14, and 21, and W. C. Liverpool and Manchester, 1st, 2d, and 3d time, March 22, April 14 and 21, and W. C. London and Birmingham, 1st time, April 21. London and Greenwich, 1st, time, April 21. London and Southampton, 1st time, April 6. Manchester and Leeds, 1st, 2d, and 3d time, April 6, 18, and 21, and W. C. North Midland (Leeds and Derby), 1st, 2d, and 3d time, April 6, 18, and 21. Oxford and Great Western, 1st and 2d time, April 6 and 21. Preston and Wyre, 1st, 2d, and 3d time, April 6, 21, and 26. Sheffield and Manchester, 1st, 2d, and 3d time, April 6, 14, and 26, and W. C. South-Eastern (London and Dover), 1st and 2d time, April 6 and 18. Taff Vale, Merthyr Tydfil, 1st and 2d time, April 6 and 18. Whitby and Pickering, 1st, 2d, and 3d time, March 22, April 11 and 21.

OBITUARY.—March 7, died, of the influenza, Mr. William James, the original projector of the Liverpool and Manchester Railway, and likewise of several other public works. Mr. James was once a man of considerable property and influence; and during his prosperity it was that he planned the above and other great undertakings, which now are of so much value to the country, and to the parties interested. The Editor of this Journal has himself seen the plans and sections of the designs by Mr. James, executed in a manner that would do credit to the first engineers of the age. Mr. James had the misfortune, like many other founders of great and mighty undertakings, to have a mind far in advance of the age in which he lived. He had the singular happiness indeed to live to see his ideas not only realized, but realized with a success incomparably exceeding his most sanguine anticipations. But such are this country's much-boasted justice and generosity, that while Mr. James sank from affluence to almost penury, and in the midst of the most splendid success to his public projects, others have risen, on the fruits of his labours, to opulence and renown.

# PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on										
					Mar.		April.								
					31.	4.	7.	11.	14.	18.	21.	25.			
9,500	.....	(3) Birmingham and Derby .....	£.	£.											
7,500	.....	(3) Birmingham and Gloucester .....	.....	10	3½					1½	9½	¾			
	.....	(2) Birmingham, Bristol, and Thames Junction .....	20	3											
15,000	.....	(2) Bristol and Exeter .....	100	2	4½										
660	.....	Calcutta and Saugur .....	50		8										
350	.....	Cheltenham .....	100												
7,500	.....	(3) Cheltenham and Great Western .....	100	7½											
14,000	.....	(4) Cheltenham, Oxford, and Tring .....	100	5						1½					
2,000	.....	(2) Clarence .....	100	100											
12,000	.....	(3) Commercial Blackwall .....	50	2	1½		1					¾			
8,000	.....	(4) Dublin and Kilkenny .....	100	2½											
7,500	.....	(4) Durham South-West Junction .....	20	3											
60,000	.....	(3) Durham Junction .....	100	10											
64,000	.....	(2) Eastern Counties .....	25	2	½				½		½	½			
5,000	.....	Edinburgh and Dunbar .....	.....	2											
13,000	.....	(3) Edinburgh, Leith, and Newhaven .....	20	3					2						
800	.....	(4) Edinburgh and Glasgow .....	50	2											



# PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on									
					Mar.	April.								
						31.	4.	7.	11.	14.	18.	21.	25.	
15,000	.....	(3) Midland Counties .....	50	5										
12,000	.....	(3) North Midland .....	100	10			9½	9	8½	.....	6	4½	9½	
2,500	.....	(3) Northern and Eastern .....	100	6										
2,600	.....	(2) Preston and Wigan .....	.....	20										
4,000	.....	(2) Preston and Wyre .....	.....	28										
1,000	6d. per c.	(3) Sheffield and Rotherham .....	25	6										
1,500	.....	(1) Stockton and Darlington .....	100	100										
3,000	.....	(2) Stanhope and Tyne .....	100	2½								3		
28,000	.....	(4) South Durham .....	.....	7			3½	.....	3½	3	3	7		
24,000	.....	(2) South-Eastern and Dover .....	50	2			1½	17	.....	.....	7			
	.....	(4) Do. Brighton, Lewes, and Newhaven .....	50	1										
40,000	.....	(4) South Midland .....	50	1										
9,000	.....	(4) South-Western (Stevenson's) ..	50	2½										
6,600	.....	(3) Thames Haven .....	50	1										
1,400	.....	(4) Victoria .....	25	2										
6,000	.....	(4) Westminster and Greenwich .....	50	3										
	.....	(3) York and North Midland .....	50											

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of  $\frac{1}{4}$  in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

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NEW SERIES.

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*Calculation of the Effects of the Atmosphere in resisting a  
Railway Train.* By the EDITOR.

Nor long after this journal came under my direction, I observed, in Mr. Joseph Gibbs's Report on the Brighton Lines, a covert attack on the theorems I had previously published for determining the comparative velocities of railway trains. Mr. Gibbs showed from the experiments of Pambour, that the relations I had given between the velocities and loads did not at all hold good in practice. Indeed, from the experiments he there cited, I saw clearly that there must be something omitted which held a most powerful influence in regulating the velocity; for velocities which in theory ought to have been 50, 60, or more miles an hour, appeared in practice not to exceed 40. In some cases it actually seemed that the practical velocities did not rise to above half what theory would have given. Surprised at such discordancies in matters which appeared too simple to involve any difficulties that may lead to error, I was instantly induced to look elsewhere for the cause of the anomalies. The first thing that struck me, was that the atmosphere, though its resistance compared with the momentum of the moving train was insignificant, and nearly inappreciable—it being perhaps in a velocity of 30 miles an hour, not the 2,000th part of the absolute load—yet, as respects the friction of the load, which is only about 8lbs. to the ton, it may become a matter of moment.

Having obtained approximate quantities to the opposing surfaces of the trains, I made some computations accordingly, and was gratified to find that the mighty and sole foe which had destroyed the utility and concord of our previous rules, was indeed the hitherto disregarded atmosphere.

This comparatively weightless body I now found was

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capable of sometimes doubling and even tripling the load, and might be even a greater enemy to cope with than steep inclines, if the transit was very rapid.

But though I had no longer any doubt of the true cause of the anomalies between my theorems and the results of practice, I perceived there was considerable difficulty in rendering them of practical utility, in consequence of the troublesomeness of the calculations, the problem being no less than the reduction of a cubic equation (p. 205, No. VI.) I have, therefore, in all practical cases had recourse to other means for estimating the resistance of the atmosphere, but which, a pressure of other matter has for several months prevented me from laying before my readers.

These very simple means I shall here give, and the more readily as they may enable experimentalists easily to reduce theoretical to practical quantities, or to clear the results of observation from the troublesome interference of an element, which has hitherto much embarrassed them, and retarded the advancement of scientific research into the actual operations of those most useful and powerful substitutes for animal labour, locomotive steam-engines.

If it be to clear observed velocities from the effects of the atmospheric resistance, the method is exceedingly simple.

Example 1. Suppose an engine in a still atmosphere, on a level, takes along a train of the gross weight of 35 tons, 30 miles an hour, the exposed surface being 50 square feet, what is the velocity at which, *cæteris paribus*, this engine would travel in a non-resisting medium?

By referring to our table, p. 95, vol. I., we find, col. 4, the additional load for 10 square feet of surface is 4.32 tons, at a velocity of 30 miles an hour. Therefore,  $4.32 \times 5 = 21.60$  tons, is the actual addition which the atmosphere adds to the duty of the engine in this particular case; and the gross duty of the engine is, therefore,  $35 + 21.60 = 56.60$  tons, instead of 35. Hence, then, and since the velocities are reciprocally as the loads,  $35 : 56.60 :: 30 : 48.52$  miles per hour, with which the engine would take along a gross load of 35 tons in a non-resisting medium.

Ex. 2. Other things alike, suppose the wind is blowing against the train at the rate of 12 miles an hour, what then would be the velocity?

Here the train meets the atmosphere with a velocity of 42 miles an hour, and the atmospheric addition is  $8.46 \times 5 = 42.30$ . So that the duty of the engine is  $35 + 42.30 = 77.30$  tons; and the  $35 : 77.30 :: 30 : 66.26$

miles per hour the engine would travel, was there no obstruction from the atmosphere.

Had the wind been blowing 12 miles an hour in the direction of the carriages, the opposing air would then have met the train with a velocity of  $30 - 12 = 18$  miles an hour.

And was the train going obliquely to the wind, the velocity of the wind must be multiplied by the cosine of the angle of its direction with the motion of the train, to reduce it to the line in which the train is actually travelling.

But in such a case as this, the neglected part of the wind, namely, that which blows perpendicularly, will produce a very sensible retardation over and above that part which refers to the direct action, for two reasons. First, because it would insinuate itself between the carriages of the trains, and thereby act by way of resistance on a greater quantity of surface than if it blew directly with or against the course of the train. Secondly, because it will tend to drive the carriages against the leeward rails, and, hence, cause pressure against the collars of the axles, and probably produce friction between the flanges and the rails. It is also highly probable, since driving the carriages towards one rail will force a part of the wheel of a greater diameter on this rail and of a less on the other, that such side wind will create considerable lurching in the trains, and of course a friction beyond the pale of calculation. I think I have a recollection myself of this lurching effect, during my experiments on the Liverpool and Manchester line, with a side wind, over Chat Moss; but not having any idea at the time of the cause, I made no note of it.

That part of the friction occasioned by the side wind, which is due to the pressure against the collars, is without difficulty subject to arithmetical calculation; and so possibly may be that arising from the friction of the flanges against the rails; and that also which grows out of the atmosphere insinuating itself between the carriages; but as to the friction due to the lurching or rolling from side to side of the trains, I believe, as I have hinted, it cannot be reduced to fixed and tangible laws. It may, however, be diminished by limiting the play of the wheels on the rails, but cannot be altogether prevented, inasmuch as some play, particularly in curves, is indispensable to the working of the engines around them.

However successful, therefore, we may be in computing theoretically the effects of the atmosphere in the case of



direct winds, we fear we should find some difficulty in harmonizing theory and experiment in oblique winds; or, perhaps, even in harmonizing experiment with experiment.

Having made these observations, I shall confine my future inquiries to the case of direct winds.

Ex. 3. The same things remaining as in the former examples, in regard to the tonnage and exposed surface, let us suppose the train to be travelling up an incline of 57 feet a mile, at a rate, suppose, of 10 miles an hour, the wind blowing down the plane 15 miles an hour; query, at what rate would the train travel up the incline, and on a level, if there was no resistance from the atmosphere?

The wind here meets the train with a velocity of 25 miles an hour, which, by the table, gives a load of 3 tons for 10 feet of surface exposed, and therefore of 15 for 50. But in climbing a slope of 57 feet a mile, the engine, on account of gravity, must exert a force 4 times greater than it need on a level, and therefore the load is  $35 \times 4 = 140$  tons, exclusive of the atmosphere, and of  $140 + 15 = 155$  tons, including it. Hence  $140 : 155 :: 10 \text{ miles an hour} : 11.1 \text{ miles an hour}$ , the velocity sought on the incline; and  $35 : 155 :: 10 : 44.29 \text{ miles an hour}$ , the velocity sought on a level.

A curious question now arises, as to what is the actual velocity a train would travel down a given incline greater than the angle of repose; that is, down a plane descending more than 19 feet a mile, if left to its own gravity and the resistance of the atmosphere. This we shall answer presently.

The cases considered above are exceedingly facile; but the converse of them, namely, to find the practical from the theoretical velocities, are much less obvious. It is here the difficulties of the cubic equation present themselves; which are those we propose to elude.

Our readers will easily comprehend the difference of the two cases, if they reflect that in the one we have considered, we have, from the actual work done, got the capability of the engine at a given velocity; because, at that velocity, we know both the real load and the superinduced load of the atmosphere, from which, by simple proportion, as we have shewn, we find the velocity in vacuo, or the theoretical velocity. In the other case, we have the theoretical velocity only, or that velocity at which the engine can take the load alone without any encumbrance from the atmosphere. At this velocity it is evident the engine could not draw its load

through the air. But at all inferior velocities the power of the engine becomes greater, and the resistance of the air becomes less; so that at some inferior velocity the engine's power exactly balances the load augmented by the resistance of the air. This is the point we want to find; and the obstacle we have to encounter in it is, that the increase of engine power follows one law and the decrease of atmospheric resistance another.

In all these, and the following cases, it must be borne in mind that we are speaking of gross loads, in which the engine, its fuel, tender, and all the carriages are included.

Now, if the actual load be multiplied by its theoretic velocity, and then successively divided by all the inferior velocities, the quotients will be a series of imaginary loads, all greater than the real load. If from these we take the given load, the remainders will ascend as the velocities to which they correspond descend. Ranging these with their corresponding velocities tabularly, and the resistances taken from the fourth column of our above-mentioned table, due to the exposed surface by the side of them, there will be one velocity at which the remainder will be equal to or exceed the corresponding resistance, and at the next superior velocity the remainder will fall short of its corresponding resistance. From these premises, the intermediate point at which the two are equal, may be determined very nearly by simple proportion.

We need not, however, run down through all the inferior velocities, which, if the theoretic velocity was very high, would be much too troublesome. A little attention will enable us to discover the point desired, very nearly, so as to have not more than two or three computations.

Ex. 4. Retaining the same exposed surface, 50 square feet, and gross load 35 tons as before, what would be the actual velocity on a level, the theoretic being 44.3 miles an hour?

At 44 miles an hour by our table, we shall find the superinduced load of the atmosphere would be upwards of 46 tons. It is evident therefore we must look much lower in the table for the equality we want, since the remainder at this point must be very small. At 28 miles an hour the remainder is  $35 \times 44.3 \div 28 - 35 = 55.4 - 35 = 20.4$ ; and the resistance on 50 feet of square surface,  $3.76 \times 5 = 18.80$ . As 20.4 exceeds 18.8, the point sought, or actual velocity, is evidently higher up. At 29 miles an hour, the remainder is 18.45, and the resistance greater, that is, 20.15. It is

manifest, therefore, that the velocity sought lies between 28 and 29 miles an hour. Now, if we take the difference between each of the remainders and the corresponding resistance, the sum  $1.6 + 1.7 = 3.3$ , is to 1 mile, as 1.6, the difference at the lower velocity, is to .49, the distance above 29 miles, at which the remainder becomes equal to the resistance. That is, at 29.49 miles per hour, the engine will take along its load in a still air.

The result we have here given is not mathematically accurate, but a very good practical approximation. If we want a closer answer, it would be advisable to compute the remainder and resistance for 30 miles an hour, and proceed by the method of second differences; a process well known to mathematical readers, and which I may hereafter reduce to very easy calculation, by the aid of tables I have long since computed.

By the above example it appears that a still atmosphere actually takes off no less than  $44.3 - 29.5 = 14.8$  miles per hour from the performance of the engine. From this example, whose conditions are not much different from those of an ordinary passenger train on the Liverpool and Manchester line, we perceive the immense influence of the atmosphere even in its most passive state.

Ex. 5. Other things alike, let the wind now blow in opposition to the course of the train, at the rate of 15 miles an hour, which is a brisk pleasant wind; required the velocity the train will travel at?

Here, when we have calculated the remainders according to the preceding method for the inferior velocities, we must add 15 miles to each of these velocities, to find the corresponding resistance form. Let us begin at 25 miles an hour, the remainder is  $35 \times 44.3 \div 25 - 35 = 62.02 - 35 = 27.02$ . Adding 15 to 25, we have 40, and the resistance by the table on 50 square feet, is  $7.67 \times 5 = 38.35$ , which being above the remainder, shows that this velocity is too high. Proceeding in the same manner with the inferior velocities, we shall find 24 miles give a remainder of 29.60, and a resistance of 36.5; 23 miles give a remainder of 32.41, and a resistance of 34.65; and, 22 miles a remainder of 35.47, and a resistance of 32.85. Ranging these quantities, we have,

Miles per hour.	Remainder.	Resistance.	Diff.
22	35.47	32.85	+ 2.62
23	32.41	34.65	- 2.24
24	29.60	36.50	- 6.90
25	27.02	38.35	- 11.33

Between 22 and 23 miles an hour, therefore, must be the travelling velocity of the train. And  $2.62 + 2.24 = 4.86:1::2.62:54$ . Therefore the velocity sought is very nearly 22.54 miles an hour; that is, about 7 miles an hour less than the preceding, and little more than half the rate the train would travel at in a non-resisting medium.

These two examples will serve to show the immense influence the wind has over the speed of a railway train, and how extremely absurd it has been all along to neglect it, more particularly in the construction of the first carriages of the trains. I may probably recur to this subject hereafter. There is a possibility of even turning the resistance of the air to some account, so as actually somewhat to lighten the load itself, by a judicious figure to the train carriages, and perhaps otherwise to diminish the duty of the engine. But the subject, viewed in all its bearings, is one of even some scientific difficulty, and will require considerable care in its analysis. Might not, however, a mechanical contrivance be easily constructed to call in the aid of the wind to help the operations of the steam in turning the wheels of the engine? In this way, side winds might be rendered eminently serviceable; and we might thus make a very useful friend of a powerful foe.

The general reader will not fail to have inferred much less of certainty in the travelling of railway trains than the advocates of railways have held out. Were the engines always to be working at the top of their power, as we have necessarily assumed, this would inevitably be the case. But, in practice, it is not so. Rarely are the engines so working. They have generally considerably more power in store than they want, which they can exert, or not, as needed. Hence the certainty of time resolves itself into a simple question of expense, as regards a single journey, which is again counter-balanced in the opposite, so as, in fact, to produce no extra expense to the company in the aggregate.

Ex. 6. The same things continuing, let us inquire at what rate such a train as we have supposed would run down a plane of 57 feet to the mile, by its force of gravity alone, in a still atmosphere.

The force of gravity is here three times the common friction, or traction, and the accelerative force is therefore a constant quantity of twice the traction, or reckoned as a load, is 70 tons. This by a glance on our table is 54 miles an hour very accurately.

Had the plane descended only 38 feet per mile, the acce-

lative force would have been just equal to the traction, or, in a load, equal to 35 tons. The velocity of descent, under the same circumstances, would therefore, according to the table, have been a trifle greater than 38 miles an hour.

In the example the plane falls somewhat less than the celebrated Whiston and Sutton planes on the Liverpool and Manchester line, and the resulting velocity exceeds, by 4 or 5 miles an hour, double that at which the men are directed to allow the carriages to run down. How far 54 miles an hour is an unsafe velocity to travel at, is a question. If it be not unsafe on a level, it remains to be considered whether it can be much more unsafe down this incline, which, to sense, is so little of a descent as to be scarcely distinguishable to the eye. If it be decided not to be unsafe, a very important practical problem is solved, namely, that such an incline cannot, from any neglect of the brakesman, unless when the wind is blowing with the train, become so dangerous in practice as theory would represent it to be, provided the steam be cut off.

Another problem, of scarcely less practical importance, also gains a great step towards its complete solution. It is this. *Is it better in practice to have a line continually ascending to a lofty summit by nearly one continued gradient, greater than that characterizing the plane of repose, and then descending by nearly the same gradient to the other terminus? or is it better to have a succession of alternations of rising and falling at inferior gradients?*

If we compute the practical velocity up a plane of 38 feet per mile, by the preceding methods, we shall find it about 14·07 miles an hour. And since the velocity of the train down such an incline, if abandoned to its gravity and a still atmosphere, would be, as we have just computed, 38 miles an hour, the mean velocity would be half the sum of the two, or better than 26 miles an hour. This is within  $3\frac{1}{2}$  miles an hour of the actual working velocity on a level. Here, however, it will be observed that the engine in whose wear and tear and fuel, by far the chief part of the expense of transport lies, works only half the way. For the other half, it may be carried down on a truck, without any other expense than the wear and tear of the truck itself. But in the half it does work, the exertion, and we presume, therefore, the expense, will be about 2·1 times greater, taking in the resistance of the air. So that the expense connected with the engine averages very little more for the whole line than if it had been a perfect level.

Now, if the plane was only half the inclination, or 19 feet a mile, the mean practical velocity up, found by the preceding methods, is about 19·58 miles an hour, and down the incline, 40·15 miles an hour, full steam being applied. The mean of these two is 29·86 miles an hour, that is, about  $\frac{1}{3}$  of a mile quicker than on a level.

Here then apparently an extraordinary consequence follows, namely, that in actual practice an engine may take a load up and down two long planes rising and falling 19 feet per mile, or up and down planes characterized with being inclined to the horizon in the angle of repose, with a greater mean velocity than it could take the same load over an equal space on a level. But this does not prove that it will be taken the whole distance in a less time. There is, however, a circumstance involved that has much better claims to be considered extraordinary. It is this, that full steam may be practically applied down slopes, and with perfectly safe and reasonable velocities, where it was hardly ever dreamt it could be applied at all.

But, to the main question. It has been given in evidence, I believe, that an engine wears and tears more in going down an incline, on account of the much greater velocity, than it does in going up with its load. If so, the wear and tear up a slope of 19 feet a mile, being about 1·5 that on a level, taking into account the resistance of the air, the whole wear and tear will be 50 per cent. more than on a level, and therefore near 50 per cent. greater than in ascending and descending the 38 feet a mile. It would therefore follow that lines of railway with gradients, now considered objectionable, might, if laid out in long lengths of continued ascent and descent—as the Sheffield and Manchester, given in our eleventh number—be actually worked more economically than others with much easier gradients if short and alternating. Would not these consequences lead to an explanation of many things in the American statements, now regarded as extravagant?

In making these observations, I have gone much farther than I at first intended, but not anyways far enough for the importance of the subject. My object has been to stimulate others to (I think I may say) a new and deeply interesting branch of railway science, namely, the difference between what may not improperly be termed the scientific theory and scientific practice of locomotion. If my object of stimulation is attained, I feel confident, in the hands of more competent persons, the pursuit will prove rich in its

results and in utility. I candidly confess that in only writing so far, things have opened to me quite new and unanticipated, and I only regret I have not the time to pursue them farther.

EDITOR.

*A Light for the Diving Bell.* By WM. MAUGHAM, Esq.

TO THE EDITOR OF THE RAILWAY MAGAZINE.

DEAR SIR,—Some time ago a gentleman applied to me to furnish him with a light that might be employed for enabling a person to see to work under water, after going down in the diving-bell. He was desirous of using the light which is obtained by means of lime and the combustion of the mixed gases, oxygen and hydrogen; but I at once told him this would not be found practicable. The plan which I now propose of producing a light under water, I beg to lay before the public, through the medium of your valuable journal. Let the two poles of a voltaic battery be made of sufficient length to reach the required depth, and let these poles (made in the usual manner, of thick copper wire) be well coated with sealing wax, pitch, or any other convenient insulating substance; at the extremities of these wires, two charcoal points are to be fixed, in the ordinary way. When these points are brought together under water, a brilliant light will be produced, which will enable a person to work under the water by night. That the electric light may be produced in this manner under water, has been long known to those who are familiar with the phenomena to which voltaic electricity gives rise; but I am not aware that the above application of it to which I now call your attention, has suggested itself to any other person. In consequence of the various improvements which are daily taking place in the voltaic arrangement, it is very probable that at no very distant period, an efficient and cheap *sustaining* or *permanent* battery will be contrived, and then this light may be kept up for any required length of time under the water, at a very trifling expense. In the mean time I would suggest the trial to be made with a series of plates, arranged on Professor Daniels' plan, and if I can afford assistance to any of your readers who may be desirous of seeing how far the plan is practicable, they may command my services.

I remain, Sir, yours very truly,

Adelaide-street Gallery,

W. MAUGHAM.

May 1, 1837.

*Railway from Hull to Selby.* By A SHAREHOLDER.

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TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—I coincide in the opinion which has been repeatedly expressed in your Magazine, that notwithstanding the present depression in railway shares generally, those undertakings which are *really legitimate*, and likely to pay the shareholders, will soon attain the place in public estimation to which they are entitled; whilst such will be given up as have been projected without due consideration, and where the object of the promoters of them has been merely to avail themselves of the credulity of parties who might be induced to purchase the shares at a premium, without reflecting upon the merits of the undertaking.

It is very desirable that information respecting the railways already in existence, or which are contemplated, should be brought before the public, and I do not know a more suitable medium for this purpose than a Railway Magazine. On this account, I am induced to trouble you with some observations relative to the railway from Hull to Selby. The length of this line, from its commencement at the quay of the Humber Dock, Hull, to the junction with the Leeds and Selby Railway, at Selby, is  $30\frac{1}{2}$  miles, and on account of the numerous advantages which it possesses, it has been designated, by competent judges, "the finest line in England" of such a length, and which will be easily proved.

For a continuous distance of about 18 miles, the railway will be in a *perfectly straight line*. There are very few curves, and the radii of them are as under, viz:—

1 of 3767 yards.	1 of 2498 yards.
1 of 9411 do.	1 of 6285 do.
1 of 6190 do.	1 of 4883 do.
1 of 5558 do.	1 of 537 do. at Selby.
1 of 1796 do.	

These are so exceedingly favourable, that the line may be considered to be practically straight for the whole distance.

In another and most important point of view, this railway is unrivalled. I refer to the *gradients* of the line, which are as follow, commencing with the Selby end, viz:—



## STATEMENT OF INCLINATIONS.

Lengths.		Rates of Inclination.		
Miles.	Chains.	Rise.	Fall.	
	20	1 in 290	.....	} Bridge over the Ouse.
	40	.....	1 in 290	
1	12	Level.		
1	56	1 in 561		
1	36	.....	1 in 1531	
	38	.....	1 in 330	} Bridge over the Derwent
	27	1 in 330	.....	
1	67	Level.		
1	2	.....	1 in 782	
1	...	1 in 948		
1	10	.....	1 in 3036	
4	40	.....	1 in 2250	
	40	1 in 330	.....	} Bridge over the Market Weighton Canal.
	40	.....	1 in 330	
1	...	1 in 744		
3	...	Level.		
2	40	1 in 765		
2	...	.....	1 in 656	
5	72	Level.		
<hr/> 30 60 <hr/>				

From the above statement it will appear that, proceeding from Hull, there are nearly 12 miles perfectly level,—the same distance with a trifling fall, and about  $7\frac{1}{4}$  miles with a small rise,—probably no other railway of the same length possesses such favourable gradients, and the great advantage which results from them is not merely the difference in the expense of forming the railway, but the saving which will be hereafter made in the annual outlay for maintaining and working it. This difference, as compared with other railways not so favourably circumstanced, will be very great. Mr. George Stephenson, in his Report to the Glasgow, Paisley, and Greenock Railway Company, has stated a decided opinion, that in the case of a railway with very favourable gradients, *one-third* of the gross revenue will be quite sufficient to pay all contingent expenses. Such a railway is that from Hull to Selby, and if your readers will refer to the conspectus of the traffic on the Liverpool and Manchester Railway for six years, which appeared in the

"Railway Magazine" for April, they will see the enormous difference which arises where a line is favourably circumstanced in this respect. The gross receipts upon the railway referred to, for the six years, ending 31st December, 1836, are 1,146,166*l.* The total disbursements for the same period, amount to 696,629*l.*, or above 61 per cent. thereon; whereas, if the line had been so favourable that one-third of the receipts would have covered the expenses, the *saving* to the Liverpool and Manchester Railway Company would have amounted to no less than 314,574*l.* in the before-mentioned period of six years, or upwards of 52,400*l.* per annum!! The statement of Mr. Stephenson, with reference to the probable expenses on a line with very favourable gradients, must have great weight, on account of the experience which that gentleman has had in railways, more especially as he is the engineer\* of the Liverpool and Manchester Railway Company, and therefore well acquainted with the expenses of that line, as well as the *causes* of them.

The Hull and Selby Railway not only possesses the valuable properties already enumerated, but when the probable traffic upon it is considered, it will be found scarcely, if at all inferior in this respect to any other line in the kingdom; and this is certainly the most important consideration, as the proprietors would derive little consolation from possessing a line enjoying every other advantage, *if this were wanting*, profit being very naturally one of the objects they have in view.

When the Bill for making this railway was before the Committee of the House of Lords in the last session of Parliament, it was observed by the Noble Lord who was the chairman of that Committee, that there could not be a difference of opinion with respect to the advantages which would result from a railway between Liverpool and Hull, connecting the eastern with the western coast of England by railway communication. Hull may be termed the eastern, as Liverpool is the western port for the exportation of goods from the manufacturing districts of Yorkshire and Lancashire; and as there are already railways in operation between Liverpool and Manchester, and from Leeds to Selby, and Acts of Parliament were obtained in the session of 1836 for the two remaining portions, viz., from Manchester to Leeds, and from Hull to Selby, which are already

\* We have heard that Mr. Stephenson is not now the engineer.—ED.

in progress, there is no doubt the communication between Liverpool and Hull by railway, will be completed at no very distant period, and the continuous communication will very materially benefit all parties interested in the different lines.

It would be superfluous to describe Liverpool as a place of immense and increasing traffic and importance, with a population of probably 200,000 persons. Manchester is unrivalled by any other provincial town in the United Kingdom for wealth, and the extent and importance of its manufactures: it is the capital of the cotton manufacturing district; and Mr. Stanway, the Secretary to the Manchester South Union Railway Company, in the evidence which he lately gave before a Committee of the House of Commons, stated that its population was now 305,000; that by the Stamp-office returns, there are 2,424 stage coaches which run to and from it every week, being a larger number than in any other place in the kingdom, *London alone excepted*; and the population of the surrounding district is immense, Lancaster being the most populous county in England, excepting Middlesex. Yorkshire is nearly equal to it in population, and the magnitude and importance of the manufacturing district in the West Riding of this county, as well as its wealth, are well known. Leeds may be considered the capital, with a population of considerably more than 100,000 persons, exclusive of the densely-populated towns in its neighbourhood.

We now come to consider Hull, ranking next to Liverpool as a sea port, on account of the magnitude of its trade and commercial importance, being greatly superior to Bristol in these respects, as a comparison of the tonnage frequenting the two ports will show. No town in the kingdom is more favourably situated for commerce than Hull, being upon the banks of the Humber, by which merchant-vessels of the largest class have access to it; and in addition to the harbour, which is capable of accommodating an immense number of vessels, it has three of the largest and most convenient wet docks in the kingdom, which communicate with each other, and also with the harbour and the Humber. The population of the town and suburbs is about 60,000, and the regular increase of its trade will be strikingly apparent from the following comparative statement of the principal articles imported and exported during the last three years, which has been compiled principally from official returns:—

## IMPORTS.

	1834.	1835.	1836.
Flax of all sorts . cwts.	94,684	101,450	164,563
Hemp do. . . . cwts.	68,338	47,676	82,352
Rapeseed . . . quarters	43,362	96,294	49,464
Linseed . . . . quarters	79,788	92,816	133,085
Hides and skins . cwts.	39,071	34,156	38,839
Bark for Tanners' use . . . . cwts.	179,795	135,648	142,039
Wool, sheeps . . lbs.	9,518,546	14,144,580	21,367,010
Wine . . . . gallons	164,442	231,388	181,875
Iron bars . . . tons	9,258	12,832	13,612
Tallow . . . . cwts.	25,197	27,768	47,560
Oil of olives . . tons	1,285	.....	1,328
Cloverseed . . . cwts.	18,255	24,825	17,880
Currants . . . cwts.	11,959	14,022	10,460
Raisins . . . . cwts.	7,509	4,975	4,294
Madders . . . cwts.	22,896	20,130	25,845
Spirits . . . . gallons	162,252	196,181	140,707
Brimstone . . . cwts.	3,498	23,639	11,345
Timber . . . . loads	25,065	39,849	35,270
Deals and battens pieces	1,368,360	1,570,680	1,297,080
Turpentine . . . cwts.	5,959	14,116	8,692
Cakes, linseed . . cwts.			135,328
Cakes, rape . . . cwts.			37,310
Rags . . . . . cwts.			18,882
Bones . . . . . tons			24,309

## EXPORTS.

## Cotton manufactures, viz ;—

	1834.	1835.
Stuffs of all sorts entered by yard yards	51,299,847	56,852,400
Lace and net . . . . . yards	25,025,367	30,262,758
Shawls and handkerchiefs . . dozens	34,219	28,782
Hose . . . . . doz. pairs	410	2,146
Yarn and twist . . . . . lbs.	44,120,595	57,291,498
Earthenware . . . . . pieces	1,854,050	1,996,700
	& 7,400 Potters' d. zens.	& 6,400 Potters' d. zens.
Hardware and cutlery . . . cwts.	15,785	16,481
Iron and steel, wrought and unwrought . . . . . cwts.	47,736	96,929
Lead and shot . . . . . cwts.	9,109	8,316

## Linen manufactures, viz :—

Linen entered by yard . . . yards	90,344	183,526
Sail cloth . . . . . ells	11,002	8,899

EXPORTS—*continued.*

	1834.	1835.
Yarn and thread . . . . . lbs.	824,552	2,059,655
Bags . . . . . number	13,674	8,232
Machinery and mill work . . value	£11,838	£19,523

## Silk manufactures, viz:—

Stuffs, &c., entered by lbs. . . lbs.	6,434	3,140
Ditto, by yards . . . . . yards	4,461	8,526
Silk handkerchiefs . . . . . dozen	101	349
Thrown silk . . . . . lbs.	6,448	14,867
Hosiery . . . . . value	£9,718	£6,363
Tin plates . . . . . value	£4,576	£17,899

## Woollen manufactures, viz:—

Cloths and stuffs entered by piece pieces	410,427	518,564
Flannel and carpeting . . . yards	699,246	662,712
Shawls and coverlids . . . number	36,058	39,458
Hose . . . . . doz. pairs	10,432	6,703
Woollen and worsted yarn . . cwts.	10,352	14,579

I have not obtained the quantities of goods exported in 1836, but they are considerably larger than in 1835; and it is understood between sixty and seventy millions of pounds weight of cotton twist alone were exported; and the amount of duties received at the Custom-house in 1835, was 720,870*l.* 14*s.* 2*d.*, and in 1836, 801,630*l.* 13*s.* 3*d.*, being an increase over 1835 of 80,759*l.* 19*s.* 1*d.*

The dock duties received in Hull during the last five years, are as follow, viz:—

1832—3,240	ships	340,332	tons.
1833—3,434	—	354,237	—
1834—3,610	—	392,548	—
1835—3,813	—	413,135	—
1836—8,954	—	503,165	—

showing an increase of nearly 50 per cent. in the amount of tonnage frequenting the port between 1832 and 1836, and the preceding statement shows that the increase has been *gradual*, and not occasioned by any unnatural speculation.

The number of steam-vessels which proceeded from Hull to Hamburg in 1835, was 97; in 1836, it was 154, exhibiting an increase of 57, and making an average, including the winter months, of nearly 3 vessels *to* Hamburg, and the same number *from* Hamburg every week: and the

amazing addition to the number of steam-vessels trading to and from Hull will be apparent from the following copy of an official return which was lately presented to the House of Commons:—

*An Account of the Number of Steam-vessels, and the Amount of their Tonnage, entered inward at this Port during the last four Years respectively, up to the Year ending the 5th January, 1837.*

FOREIGN PARTS.			COASTWISE.		
Year.	No. of Vessels.	Tonnage.	Year.	No. of Vessels.	Tonnage.
1833	60	9,890	1833	153	22,260
1834	135	23,857	1834	203	30,736
1835	149	26,873	1835	243	35,356
1836	155	31,301	1836	533	81,850

The increase which the above statement exhibits is almost unparalleled, especially with reference to the number of steam-vessels employed in the coasting trade from Hull to London, Yarmouth, Lynn, Scarborough, Whitby, Newcastle, Leith, Dundee, &c.; the number of passengers to and from London alone, averaged nearly 3,000 weekly during the last summer, and it is expected the number of packets will be increased, so as to allow of one leaving Hull, and also London daily.

When all these circumstances are considered, can there be the slightest reasonable doubt that the Hull and Selby Railway will prove a good investment for capital? The towns of Liverpool, Manchester, Leeds, and Hull combined, contain a population of about 700,000 persons, and are in the line of a district with which they are immediately connected, containing nearly double that number. The London and Birmingham Railway will cost nearly five millions sterling, and there is scarcely a town of any note between the termini; nor does the Great Western Railway possess advantages at all to be compared with a line which is connected with others traversing the heart of the woollen and cotton manufacturing districts.

It may be argued that there is a free river with which the railway from Hull to Selby will have to compete, and this is readily admitted; but it is a notorious fact, that the steam-boats plying thereon can only leave Hull at certain hours, varying with the tides; and that, in coming from Selby to Hull, they are often eight, ten, and even twelve hours on the passage, in consequence of their taking the ground on the *shifting sands*, with which the rivers Humber and Ouse, between Hull and Selby, abound, and where cases occur

every year of vessels being lost and injured, and of goods being very seriously damaged. Persons coming from Leeds to Hull on business, can rarely do so at present for the above-named reasons, so as to be enabled to return in less than three days. By the railway the journey may be performed each way in about two hours; parties, therefore, leaving Leeds at six or seven o'clock in the morning, may arrive in Hull at nine, have the whole of the day to devote to business, and be able to return home *the same evening*; the saving, therefore, in both time and expense, is so obvious, that comment is unnecessary. There are *packets* between Liverpool and Manchester, but it is notorious that the railway between those towns conveys nearly all the passengers, although the *fares* by the packets are considerably lower. In these days, *time* and the *saving of expenses on the road*, are deemed to be important considerations.

With respect to goods, the *facilities* and *certainty* which the transmission of them by railway will ensure, are so great and important, that, should a trifling additional charge over the present rate of freight by water be incurred, the advantages derived will more than counterbalance it; but, owing to the canal dues being high, the probability is, that goods will be conveyed from Manchester to Hull by railway, at the rates which are now charged for them by water; and the damage, disappointment, and loss, which have been so often sustained by manufacturers and merchants, will be thereby avoided. During the last year, upwards of 30,000 tons of cotton twist, exclusive of manufactured and other goods, were exported from Hull; and of sheep's wool alone, the statement already given shows that upwards of twenty-one millions of pounds were imported into Hull to be forwarded from thence into the West Riding of Yorkshire, &c., being more than one-third of the whole quantity of this article imported into the kingdom.

The capital of the Hull and Selby Railway Company is 400,000*l.*, divided into 8,000 shares of 50*l.* each, *the whole of which are taken up*, and in the hands of parties of high respectability, and it may be stated, without fear of its being disproved, that no other company in the kingdom possesses shareholders to the same amount of capital, exceeding them in character and wealth. Whilst so many disgraceful exposures have recently been made of the means which were resorted to by other companies to obtain signatures to their contract deeds, whereby an apparent compliance with the standing orders of the Houses of Parliament might be

exhibited, not a single fictitious signature was ever obtained, or *suspected* to be obtained, to the deed of this Company; and it is gratifying to know that, notwithstanding the great disposition which was generally manifested to sell and buy railway shares during the past year, upwards of *two-thirds* of the registered shares of this Company are *in the hands of the original proprietors*; thereby evincing, in the most conclusive manner, their confidence in the line. The Directors are known to be gentlemen of high character, wealth, and prudence, who are largely interested as shareholders in the undertaking; they have devoted unremitting attention to the concerns of the Company, and the abilities of Messrs. Walker and Burges, the chief engineers, are well known and appreciated. A request has been recently made by some gentlemen, holding a considerable number of shares, to be allowed to pay the full amount of their shares, on receiving interest on the surplus above the calls which may be made, conceiving the Directors will be enabled to lay out the money advantageously for the Company; the request has been acceded to, and it is presumed that not many companies have received similar offers. Not more than 78% remains due upon the deposit and first call (together 5% per share) on the 8,000 shares, and the Chairman of the Company has lately issued a circular to the shareholders, from which it appears that there is a balance in hand of about 23,000%. Contracts, for three bridges, and other works, are already advertised for, and the circumstance of so many projected railways being abandoned, and the reduction in the price of iron, which will probably decline still further, will cause a considerable saving to the Company.

The estimated cost of the works is 384,636%.; and the following sketch of the probable receipts and expenditure, when the railway is completed, which was presented to the Committee of the House of Commons, will appear to be an exceedingly moderate one, after a consideration of the preceding statements:—

*Estimate of the probable Receipts and Expenditure on the intended Railway between Hull and Selby.*

PASSENGERS, VIZ.,	
50,000 yearly, in first class carriages, at 5s. 6d. . . .	£13,750
100,000, ditto in second class carriages, at 4s. . . .	20,000
30,000, ditto, for short distances, at an average charge of 2s. each . . . . .	3,000
	<hr/>
	£36,750



1,500 tons of goods weekly, to and from Selby, or 78,000 tons yearly, at 6s. per ton . . . . .	£23,400
Parcels, &c., goods for places on the line of railway, 30l. per week, or yearly . . . . .	1,560
Agricultural produce, also cattle and sheep, 50l. per week, or yearly . . . . .	2,600

Receipts . . . . £64,310

## EXPENSES, VIZ.,

Locomotive power, repairs, wages, &c. &c., estimated at 41 per cent. on the gross receipts . . . . .	26,347
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Surplus . . . . £37,963

Being, upon a capital of 400,000l., nearly 9½ per cent.

If the expenses are calculated upon the statement of Mr. Stephenson, that one-third of the gross receipts will cover them, the surplus will be 42,873l., leaving a profit of upwards of 10½ per cent. The probability is, that the number of passengers, and also the quantity of goods, will prove to be underrated in the above estimate, as the Hull and Selby railway will communicate with the York and North Midland, the North Midland, the Midland Counties, the Birmingham and Derby, the London and Birmingham, the Grand Junction, and also with the Great North of England Railway, an Act of Parliament for extending which to Hurworth has passed the House of Commons in the present session; and as an Act to extend the Northern and Eastern Railway from Cambridge to York will probably be obtained in the next session of Parliament, Hull will, in a very few years, have the benefit of a communication by railway to all parts of England and Scotland, the advantages resulting from which cannot now be estimated.

As the Hull and Selby Railway is an undertaking in which I feel much interest, considering it a *national* as well as local benefit, I have taken great pains to obtain such information as appeared to bear upon it, and which would enable the public to form a fair estimate of its merits; the data given are easily referred to by any person who may wish to do so; and as I consider a railway magazine to be a suitable medium through which this information may be diffused, I have sent it to you, in the hope that it may be inserted. I beg also to express a wish that the like particulars may be furnished to you relative to other railway companies.

I am, Sir, yours, &c.,

Hull, May 16, 1837.

A SHAREHOLDER.

*Life Insurances.* By SLOW-AND-SURE.

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TO THE EDITOR OF THE RAILWAY MAGAZINE.

SIR,—Some few months back I observed in your excellent publication an inquiry from one of your correspondents, as to “what description of life insurance, or what particular office, would be the best for making a provision for his family.” Since then I have looked (but in vain) for a reply from one or other of the various parties engaged in the management of such establishments; and I trust that you will, in the absence of a more able answer, allow that which I can offer to serve as a guide to your inquirer.

There is much unnecessary mystification in most insurance offices, with regard to what they call profit, which profit arises entirely from the overcharge of premium beyond the risk and expenses incurred. Such overcharge ought, in fairness, to be entirely returned to the party who paid it; but as there are almost as many ways of dividing the surplus funds arising from such overcharges as there are offices, it is clear, as but one can be right, that all the others must be wrong and unfair towards the insured. Now the plan which the Mutual Insurance Office, 37, Old Jewry, has introduced, is evidently the right and just one. This office ascertains annually the amount of surplus or overcharge, and returns it to whatever policy may become a claim within the next twelvemonth. This is exactly what every office ought to do, and it may be safely stated that whatever office does less, wrongs all its insurers; and that whatever office promises more, must benefit one set (generally the earlier) of its insurers at the expense of the remainder: nay, further, no office, however great or wealthy, the gigantic Equitable not excepted, can, in the long-run, fulfil the golden hopes and expectations, which point to more than the Mutual Insurance Office accomplishes by the unostentatious application of a new but easily understood principle, based on strict justice to all its members.

Of proprietary offices, which make either none or a partial return, retaining therefore all or a part of the overcharge, little need be said; they are imperfect in their nature, and necessarily most expensive to the assured. Cases may happen where, as a mere matter of business, they are more suitable, but, as a provision for a family, they are, from their very nature, perfectly unavailable. The Mutual,

or any other office, would gladly accommodate the public on the terms of such companies, well knowing that its own members would derive great profits, and that, therefore, the insurer must incur great loss from them. Only the most prejudiced, or the ignorant, can suffer himself to be deluded by the apparently low scale of premiums of the proprietary offices: they are the very dearest of all.

Finally, I beg to state, that I am myself a member of the Mutual Insurance Office; the Directors of this institution challenge the most minute inquiry into their principles, practice, and funds; and the only fault which I have ever heard alleged against them is, that they are a set of very quiet men; that they work hard and receive no salaries; and that they do not attempt to dazzle the public, and to impoverish their institution by building a palace, like some of their competitors, but endeavour to extend their institution without noise and advertisements. Nevertheless, they prosper, and are an example, which sooner or later must be followed by every other office, that means to remain in the field.

I am, Sir, your obedient servant,

London, May 18, 1837.

SLOW-AND-SURE.

*Improved Canal Lock.\** By JOSHUA FIELD, F.R.S.,  
V. P. Inst. C. E.

“THE numerous and extensive navigable canals by which this kingdom is intersected, have tended in a great degree to exhaust every natural source from which water for their supply can be obtained; this renders the further extension of these important channels of commerce difficult, and in many cases impracticable. Some canals are altogether supplied by artificial means at an enormous expense, others only in part, whilst the greater number, depending upon natural sources alone, are more or less in want of water, and consequently the navigation is interrupted during the driest season of the year.

“To lessen the great loss of water by the common canal locks has long been a standing desideratum amongst engineers, and perhaps no subject has engaged more talent and ingenuity than the solution of this hydrostatic problem. Numerous contrivances have been resorted to, some to save

\* From vol. i. of the Transactions of the Institution of Civil Engineers.

the whole and others part of the lockage water, many of these are beautiful in theory, and perfectly successful upon a small scale, but when they have been tried upon the full magnitude they have uniformly failed, chiefly from the circumstances of the scheme involving some prodigious moving plunger or caisson, floated or suspended; and, in most cases, this vessel has been required to be perfectly water or air tight, and poised with the utmost precision—conditions hardly to be obtained in practice, and if attained, the expense alone would defeat the object.

“When the rough usage to which canal locks are subject is considered, and the ignorance of the persons necessarily employed in the management of them, it does not seem probable that any conservative lock will succeed until the whole apparatus shall be reduced to fixed masonry, and no other machinery employed than common gates and paddles, or sluices; for of all that have been invented, and for which upwards of twenty patents have been granted, none have been brought into practice for any length of time, except those of the side-pond class, which save half the water, and which, though less simple than the common lock, consist of the same parts, and are found completely manageable by the persons usually employed on canals. Having been engaged in the execution of the largest conservative lock that has been constructed, my mind has been long engaged in the pursuit of some more simple means of effecting the same object; for very little reasoning on the subject will be sufficient to show, that every common lock full of water, let down from the upper to the lower level, possesses in itself a physical power or force sufficient to raise an equal quantity of water from the lower level to the height from which it has descended,—action and reaction, cause and effect, being equal.

“The method by which I propose to render the descending lock of water available for raising an equal quantity, is, in its simplest form, as follows:—At a suitable distance from any common lock, in any direction, I have a side-pond, or basin, of an area and depth equal to the lock, and communicating with it by a large and long culvert, rather under the lower level; the diameter and length of this culvert must be such that it will contain as much water as the lock; each end of the culvert is to be provided with a sluice.

“The lock being full, or equal to the upper level, and the side-pond empty, or equal to the lower level, the operation will be as follows:—When the sluice or valve at A, [at

the end of the culvert next the side-pond] is opened, the head of water in the lock will very gradually put the water contained in the culvert in motion, the velocity accelerating by the laws which govern the motion of fluids, until the levels of the water in the lock and side-pond coincide; at this time the column of water in the culvert will have acquired a velocity due to the height fallen, it will then continue to move forward, with a momentum that will not be destroyed, until the water has risen in the side-pond to the height from which it descended in the lock, abating somewhat for the loss of effect from the friction of the water against the sides of the tunnel, &c., the water gradually coming to rest, when the sluice B, in the side-pond, [at the end next the lock] must be shut to retain it. The converse operation is performed by opening the sluice B, when the lock will fill, and the side-pond become empty.

“The principle of this lock may be well illustrated by the vibrations of a pendulum, which, in like manner, actuated by the force of gravity, falls to the lowest point with an accelerating velocity, when it acquires a momentum sufficient to raise it up the other side of the arc, nearly to the height from which it fell, the loss being only that arising from the friction of the suspending point, and the resistance offered by the air.

“It is from the close analogy it bears to the pendulum that I judge the culvert should contain as much weight of water as the lock, that it may acquire sufficient momentum; it may contain more, but I think it should not contain less; thus the quantity of water raised will be equal to the quantity fallen, less the loss by friction in its transit. The friction against the sides of a tube or culvert is simply as the diameter of the tube, while the area is as the square of the diameter, therefore the larger the tube the less in proportion will be the friction, hence the larger the lock the more complete will be the effect, and the operation of a model cannot be, like most other models of conservative locks, so perfect as a full-size lock.

“Although a lock upon this principle has not been executed upon the full scale, I have tried it in a model of sufficient magnitude to justify the greatest confidence of its perfect success.

“The model consisted of two cisterns, five feet long by twenty inches wide, having a communicating pipe of eight inches in diameter, and forty-five feet long; a door valve, having a lever to open it, was fitted to each end of the pipe

opening into the cisterns; a graduated scale was accurately placed in each cistern, and a ready means provided of adding to or taking from the water of either cistern, as occasion might require. Experiments were then made with various differences of levels from twelve inches downwards, the results of which are here stated:—

Difference of level	In.	The water rose in the opposite cistern.....	In.
.....	12	.....	10 $\frac{1}{2}$
Do.....	8	Do.....	7 $\frac{5}{8}$
Do.....	6	Do.....	5 $\frac{7}{8}$
Do.....	4	Do.....	3 $\frac{15}{16}$

“When tried at less differences, it apparently rose to the same height; and when both the doors or valves were left open, it continued vibrating nearly an hour before it came quite to rest; and it is remarkable that the vibrations, whether twelve inches or one-eighth of an inch, were performed in equal times, namely, ten seconds. This experiment was tried in 1816.

“Having described the principle in its simplest form, and given the results of the experiments made with the model, I shall now point out several modifications that have occurred to me in applying it to the purpose proposed.

“The column of communication in the model, and so far as spoken of hitherto, is straight; but this would remove the side-pond to an inconvenient distance from the lock, and occupy much ground. This objection is removed by the” culvert forming “a volute round the side-pond or basin, by which means very little ground is required, and the sluices or paddles at each extremity of the culvert are brought very near together.”

The author then proceeds to describe a modification upon a principle “the same as that of the hydraulic ram of Montgolfier, much used in France for raising water a considerable height by a small fall;” but as he admits he should not adopt it himself, we shall not trouble our readers with it. “The experiments made by him, and those who have followed him, show that the loss by friction is not great, even in his pipes, which seldom exceeded two inches in diameter; this, with the results of my experiments with much larger pipes, leads me to expect the loss in a culvert of four or five feet diameter will be very inconsiderable. A calculation made also from the table given by Smeaton, of the head of water necessary to overcome the friction of

pipes up to twelve inches bore, at various altitudes, leads to the same result.

"The time it would take to pass a barge, or to change the level of a lock upon this principle, would certainly not be longer than is required at present, and perhaps not so long.

"I should imagine that a lock well constructed upon this principle, having the culvert very smooth, would save nine-tenths of the water, and that the change would be effected in less than one minute. On an attentive consideration of this subject, several methods have occurred to me of making the large sluices, or paddles, so as to be quickly and easily opened and shut, and of various securities in the management of so large a column in motion, with some necessary compensations, &c., which would be obvious to any one about to adopt it.

"I beg to present the foregoing remarks to the Institution of Civil Engineers, in the hope that the idea therein suggested being generally known, may lead to the practical adoption of the plan."

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### *Suggestions on the Standing Orders of the House.*

By the EDITOR.

MEASURES have at length been taken by the two Houses for the revision of the Standing Orders relative to railways. There is scarcely a company which will not be glad of this, for certainly the present Standing Orders are most unsatisfactory, unintelligible, and in many respects altogether inoperative.

I shall here make a few observations merely as additional suggestions to Noble Lords and Honourable Members.

*Of the Plan.*—By the 4th Standing Order, the map or plan is to be on a scale "of not less than 4 inches to a mile;" and when the line is to pass "through any buildings, yards, court-yards, or land within the curtilage of any building, or through any ground cultivated as gardens, an additional plan of such buildings, yards, land, and grounds, and of the said railway, shall be laid down upon a scale of not less than a quarter of an inch to every 100 feet."

In the open country, 4 or 6 inches to the mile are probably sufficiently large; but it is highly needful that all

such plans should be on one standard scale, either 4, 5, 6, or more inches to the mile, as may be thought most convenient. Perhaps no valid objection could be raised to 4 inches to the mile. But whatever is fixed on should be kept to by all. What can be more inconvenient than to have plans to as many different scales as the engineers may happen to have whims? In the Brighton lines now before Parliament, if I remember right, Mr. Gibbs's plan and section are upon one scale,—5 inches I think to the mile,—and those of the other engineers upon a different, which, when called on to compare the lines, we found not a little troublesome.

Again, the plans ought to be miled as well as the sections; and it would be advantageous if the half and quarter miles were marked on both plan and section. Corresponding portions of the plan and section, if placed one over the other, would tend much to the convenience of comparison and identification of particular points. There would be no difficulty in this if lithographed, as in most cases it is, in books. An arrow pointing north and south ought to appear in every leaf—which is frequently not done—otherwise it may be almost impossible to form an idea of the true course of the line.

Moreover, if on the plan were marked, in their proper places, the heights, in feet, above the datum line, of all the eminences and depressions within the limits of Parliamentary variation, it would be the nearest possible approach to an actual model of the country. Heights above the datum might easily be put in figures in a small circle, and depressions below it, if any, might be distinguished by a thicker circle.

With regard to that part which requires the scale to be 100 feet to a quarter of an inch, that is, 400 feet to an inch, if it is intended to mark accurately the parts occupied by the line, it is useless, since it would be barely possible to distinguish the course to a foot if the scale was four times as large, or only 100 feet to the inch. If precision is wanted, there should not be more than 50 feet to the inch.

*Section.*—The same objections hold with regard to the scales of the section. They should be fixed, and the vertical, if intended to present measurable heights, should have not more than 50 feet to the inch. To prevent inconvenience they should be referred to datum lines, 100, 200, 300, &c., feet above a fixed datum line designated by figures



under them. But, if the altitudes are carefully figured, the scale being 100 feet to the inch is not of much consequence.

It would be advisable, supposing the sections, &c. to be printed on leaves or sheets, to furnish a table of gradients of each leaf, or of the whole in one table, the numbers representing the horizontal measure, being reckoned from one terminus of the line in miles and decimal hundredths. It would not be sufficient to give merely the gradients, the vertical heights wherever the line changes its inclination should also be included.

If a table were given, one of whose columns contained the distances from one terminus in miles, and decimal tenthousandths of a mile, and the other the corresponding vertical heights of the undulating surface of the ground, above or below the rails at every eminence and depression, it would enable parties to follow the computations of earth-work, and save much time in the examination of witnesses.

If in the same table the subsoils were mentioned it would be very useful, and prevent many useless questions in Committees.

It would be much more convenient for comparison and calculation if the gradients were marked in feet per mile, than by 1 in so many; for the perpendicular of a right-angled triangle to be made the constant quantity is awkward and unscientific; every one knows the constant should be the hypotenuse.

In the case of a line joining another or becoming a branch to it, the section or gradients of the first, between the junction and chief town on it, which the new line is intended to connect with some other town, ought to be given, as a part and parcel of the other.

Again, it would appear by the Standing Orders that exactly as the line of rails is laid in on the section so it must be executed. This certainly never could have been intended; for it would cut off all improvement by deeper cutting where the subsoil turned out better than expected, and destroy the line in a bad soil, by compelling a deeper cutting than it may be found the soil would bear.

*Depositing of Plans.*—By the existing Standing Orders the plans must be deposited on or before the 1st of March, for the next session, and any alterations in the plans on or before the 30th of November following. The first of these

times is inconveniently long before the session, and tends much to increase the expenses of companies. It besides cuts off, in a great measure, the advantages of making surveys in the more favourable months of March, April, and perhaps May, previous to the crops being too high. If the plans were deposited by the 1st of June or July, engineers would find it a great advantage.

*Subscription Contracts.*—Is it needful any Standing Order for these should exist at all? We may, I presume, rest assured that no orders the Houses can frame will ever produce the effects they may contemplate. They will certainly be evaded, and as certainly only promote fraud and deception, without any protection, as it is called, to the public.

If a short, impartial, and inexpensive proof of the practicability and merits of the line, and the certainty of its paying, was devised, and an authorised report thereon published previously to the directors being allowed to receive deposits from other persons, the whole risk and expense of bringing forward a bad scheme would fall on the directors themselves, that is, the promoters, who are the proper parties. At the same time, it may be needful to limit the number of directors, otherwise they would evade the order by making all the shareholders directors, and getting the power delegated to a select few. Such precautions, it is presumed, would furnish the best protection the public could have, and the Parliament might afterwards inquire into the public utility of the project, without troubling themselves at all about that slippery article the money, or about the traffic.

We repeat, we hope Parliament will be exceedingly cautious in legislating, or endeavouring to set up any onerous measures in the shape of Standing Orders. A false step may produce direful consequences, and send large portions of our floating wealth to America, Germany, Russia, &c. where railways are constructing with great rapidity, without any of these impediments, and where the profits are generally much larger. We hear that it is contemplated to have 20 per cent. paid up; it would be a most injudicious measure, and certain to be evaded.

EDITOR.

*On proceedings in Parliament on Private Bills, more particularly Railway Bills.*

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[Since writing the preceding article, we have received the following observations from a friend of great experience in these matters, and whose opinions, therefore, are entitled to the greatest attention.—ED.]

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THE present system is found to be so objectionable, both in principle and practice, that some alteration, far more extensive than that of a revision of the Standing Orders of Parliament, will be necessary to prevent a repetition of what has taken place in the present session, on the subject of railway legislation.

It will be self-evident to all persons acquainted with the present practice, that, unless some material alterations are made, or unless some new system is adopted, the spirit of improvement and enterprise will gradually be drawn away from this, and transported to other countries, where less obstacles exist, and where success is dependent, not on haphazard legislation, but on the bonâ fide undertaking.

In order, therefore, to keep within ourselves the means of benefiting our own country, and preventing the exclusive benefits to others less shackled than ourselves, it is worthy of consideration how far improvement can be made upon the present system of railway legislation.

Let Parliament establish what Standing Orders it may think proper, in point of form, but let it at the same time entrust the merits of every individual case to a tribunal composed of persons competent to form a correct judgment upon it.

It has occurred to us that this would be best attained by the appointment of a commission, composed of military and civil engineers, and other competent persons, whose duties it would be primarily to examine into the merits of any projected line of railway, and to report thereon.

That the question of principle, as to the expediency of the line, either as an integral or as an extension of existing lines, be the first point to be decided by them. That the whole of the inquiries now taken before Committees in Parliament be restricted to those of principle and expediency, and that in all cases the questions, as affecting property, be made abstractedly cases of compensation. That the certainty of obtaining the sanction of the Legislature should depend not on any inquiries in either House

of Parliament, but on the report of the Commissioners, whose decision should in all cases be final.

As, however, the appointment of a commission for this purpose might raise a question as to the means of defraying its expenses, it may be provided that the promoters in each case should discharge those expenses from the funds of the company, and that the country should incur no expense in these proceedings.

The advantages of such a proposed alteration would be as follows :—

1. The decision in the first instance of a competent tribunal on the merits of every projected line.

2. The maturing of plans, &c., necessary to undergo such an ordeal, and the total annihilation of all visionary schemes.

3. The certainty of introducing men of capital into a project sanctioned and supported by the authority of a competent tribunal.

4. The saving of an enormous expense now incurred by a Parliamentary contest.

And, lastly, the certainty of having only the best digested plans carried into execution.

Upon such a principle it would be immaterial to what extent Parliament, by its Standing Orders, might require parties to subscribe, but it must ever be borne in mind that to ensure the successful carrying out of any project for our own internal improvement, the present uncertainty and expense of obtaining legislative powers for the formation of lines of railway, must be removed, and the public at large be taught to consider that the only means by which those powers can be acquired, will be certain when the commission shall have reported favourably upon the respective cases submitted to them.

In support of the principle herein contended for it may be observed, that Parliament in all cases of "Estate Bills" depute their authority as legislators to the judges of the land, from whom they require a report previous to the introduction of a Bill. If, therefore, in a matter of moment, only as between parties, the deputation by Parliament of their legislative powers is found to work well, where the subject is supposed to be beyond the knowledge of the legislators, it would follow that, in questions of railway Bills, where so many various inquiries become necessary, the Legislature should be supported by the corroborative testimony of a tribunal competent to form a correct judgment upon them.

## REPORTS.

REPORT OF THE DIRECTORS OF THE CHELTENHAM AND GREAT  
WESTERN UNION RAILWAY.

IN compliance with the opinion expressed at the first General Meeting of the proprietors, the Directors instructed Mr. Brunel to proceed immediately to lay down the line of the railway, definitively commencing at Cheltenham; and he has lost no time in acting upon those instructions.

The operation of making the permanent survey and levels, and the final setting out of the line, has been steadily continued. The determination to introduce every possible improvement in the detail necessarily renders this operation tedious and laborious, but the principal part is now completed; the exact line, and the position of the different works have been set out, the contracts and the drawings of all the works between Cheltenham and Gloucester, and for a considerable distance towards Stroud, have been prepared and exhibited, as well as some of the works connected with the tunnel at Sapperton. The preliminary shafts of this tunnel have been carried to a considerable depth, and are still in progress; hitherto the results of this examination of the strata have proved more satisfactory than there was originally reason to hope.

The anticipations of your engineer, of the improvements which might be introduced in the gradients and curves of the line, have been fully borne out up to the present time.

While studying to introduce all those improvements which can ultimately benefit the measure, and secure the most advantageous and economical working of the line, your Directors and the engineer have devoted their attention, and the engineer is availing himself of the present time to study every possible means of reducing the expenses of the original construction. Although your engineer is not prepared to hold out any promises on this head, he trusts it will be sufficient at present to say, that during the period which has elapsed since the setting out of the line, and until the commencement of the works, he has been, and is still, engaged in endeavouring to reduce the cost of the works, without impairing their efficiency. A Bill is now in its last stage in the House of Lords for effecting a deviation in the Great Western Railway, near the point of Junction of the Cheltenham line, which will also materially benefit the latter, by saving nearly one mile in the length of this line, and reducing the total distance to London by nearly three-fourths of a mile, and lowering the summit level of the point of junction.

Your Directors cannot but congratulate you upon the important results secured to this Company by the success of the Bills which

have been approved of by the Legislature, for the improvement and extension of the Great Western Railway.

The total distance from Cheltenham and Gloucester to the depôt at London, will be now 119 and 113 miles respectively.

From Sapperton to London there will be no tunnel, and an extensive and independent depôt at London, in a most eligible situation, is now secured to the Great Western, and is already in rapid progress of construction.

The Directors do not, of course, wish to disguise from the proprietors that difficulties have arisen, both as regards the state of the money market, and the existence of a rival company.

With reference to those arising from the money market, the Directors beg to state, that, in the month of November last, they felt some hesitation in making a call upon the proprietors, but they considered that it would enable them to effect most of the preparations which could be made during the winter months; and they have every reason to consider the payments made under such circumstances, a satisfactory indication of the general character of the shareholders.

It is sufficiently notorious that, since the time referred to, the difficulties of the money market, contrary to all expectation, have gone on increasing to such an extent as to create the greatest embarrassment in the transaction of the ordinary business of the country; the Directors feel, therefore, that though a profitable return for the money expended would arise immediately on the completion of that portion of the line between Cheltenham and Gloucester, it would not be politic, either with reference to the convenience of the subscribers individually, or to the permanent interests of the undertaking entrusted to their charge, to attempt prematurely to press forward any particular portion of the work which would require further advances, at a moment when serious difficulty is experienced by individuals in providing means for the conduct of ordinary commercial business.

As regards the difficulties consequent upon the existence of a rival company, your Directors have to congratulate you that their attempt has been ineffectual, and the promoters have been unable to carry their Bill through the Committee of the House of Commons.

Your Directors always entertained the strongest conviction that the projected Tring Railway was, in the ordinary sense of the term, impracticable; not with views limited to the mere possibility of overcoming engineering difficulties, but with reference also to the many and various combinations essential to the success of any railway. They never contemplated the probability that the Legislature would sanction it, especially after the general expression of opinion in Parliament, that, in the selection of a line of railway, an union of manufacturing, commercial, and general interests must be the main feature of consideration. Your Directors were thoroughly

satisfied that, even were such a line as the Tring Railway sanctioned by Parliament, it never would be executed; still, as the mere existence of a legal power to make a rival line might have discouraged some of the proprietors, and embarrassed the future proceedings of this Company, your Directors considered it their duty to assist the general opposition to the Tring Bill.

Your Directors pending the proceedings of that company before Parliament, could not feel any surprise that some of your shareholders, who were not intimately acquainted with the nature of the case, should have felt anxiety; but now that the Tring project has failed, and its failure has demonstrated the utter hopelessness of all attempts to establish rivalry projects in undertakings of such magnitude, involving the raising a double capital for one purpose, and has justified the opinion which all experienced promoters of railway communication have long entertained, that it is only to be accomplished in those localities where, as in your case, the wants of general and important interests can be brought to bear upon a single route, and then only by the cordial co-operation of all influential parties representing those interests, the proprietors must see that there is no longer any ground for discouragement from the cause referred to.

The town of Cheltenham having originally so warmly supported the Swindon line, the Directors could not but feel sincere regret in undertaking this opposition, on being informed that some of their old allies would be found in the ranks of the opponents; but, after a careful review of all circumstances, they were satisfied that the time would, ere long, arrive, at which the owners of property in Cheltenham would resume their former opinions. The Directors have strong grounds to believe that period has now arrived, and that, in the absence of all rivalry, and when calm and dispassionate judgment shall have fair play, the impossibility of establishing any second line from Cheltenham, will be obvious to all, and that the inhabitants will now cordially co-operate with them, in carrying into effect a line of railway which must be generally useful and profitable, and will secure many important advantages to the town, without injuring its property, or affecting prejudicially the characteristic features of the place.

To the city of Gloucester, the early completion of a line of railway which will afford the quickest communication with the metropolis, which will intimately connect its port with the manufacturing districts of the county, and which will form the continuation, and contribute to the support of its railway to Birmingham and the north, must be of sufficient importance to induce its inhabitants to abstain from the short-sighted policy of endangering such advantages by countenancing rival projects. And your Directors earnestly hope, that the Directors of the Birmingham and Gloucester Company will see the advantage of co-operating with you in an undertaking upon which much of the future prosperity of their own must depend.

Your Directors feel strongly that in both these places it will be found for the general interest of all promoters of legitimate railway communication, that the same district should not be split into adverse parties, and that all local prejudices, partialities, and jealousies should be thrown aside; and your Directors are particularly anxious that a vigorous effort should be made by all parties to carry through, simultaneously with your own line, that of the Birmingham and Gloucester, as well as an extension line between Stonehouse and Bristol, as one great chain of communication for the whole of the south-west, with the north-east, and north of the island.

Your Directors are satisfied that, if a thoroughly good understanding to this effect could be promoted, the best results must ensue; and when the immediate opening of the Liverpool and Birmingham Railway, and also, to a greater or less extent, of the Birmingham and London, and of the Great Western, in the course of the summer and autumn, shall have shown, as they assuredly will, that the amount of income is more than sufficient to justify other undertakings showing less probable traffic than yours, and shall have thus renewed the general disposition for investment of capital in all lines adapted, as yours is, for general and extensive thoroughfares, no doubt can remain in the minds of any of the profitable results of this line.

The Directors cannot conclude their Report without congratulating the proprietors on the very warm interest taken by the Directors of the Great Western Railway in the prosecution of this undertaking, without bearing testimony to their scrupulous adherence on all occasions to every pledge of support originally given; and without calling your attention to the determination of the Great Western Directors to afford, if necessary, their powerful influence and support towards carrying this undertaking into full effect, as expressed in the strongest terms in their Report to their last General Meeting of Proprietors held in London, and unanimously adopted by them.

The Directors having balloted among themselves in manner required by the Act of Parliament, beg to announce the names of the three retiring members of the Board, viz. :—

J. E. Viner, Esq., Devereaux Bowly, Esq., and T. C. Brown, Esq., from whom their colleagues have received the declaration that they are candidates for re-election at the present meeting, for which they are duly qualified.

The usual accounts of receipt and disbursement since the passing of the Act, to the 25th of December last, have been made out as required by the said Act, and are appended to this Report.

W. H. HYETT, Chairman.

Manor Office, Cheltenham, May 3, 1837.



*Statement of Receipts and Disbursements up to the 25th of December, 1836, presented to the half-yearly General Meeting of Proprietors, May 3, 1837.*

Amount received on account of capital to the 25th of December, 1836.....	31,460	0	0
Ditto, interest on account of arrears .....	5	8	7
	<hr/> £31,465 8 7		
Expenses before the passing of the Act, to the 24th of June, 1836 .	17,524	8	5
<i>Payments from the 24th of June to the 25th of December, 1836.</i>			
Engineering, surveying, &c. ....	600	0	0
Parliamentary expenses .....	3	11	6
Local agents .....	12	1	6
Printing and advertisements .....	30	0	0
General disbursements, comprising direction, office expenses, salaries, stationary, postage, &c. ....	729	8	1
	<hr/> £1,375 1 1		
	<hr/> 18,899 9 6		
Balance in hand, Dec. 25, 1836.....	£12,565	19	1

# FIRST REPORT FROM THE SELECT COMMITTEE ON THE DEPTFORD AND DOVER SUBSCRIPTION LIST.

[As an official document, we have felt it our duty to give this long Report complete, which has not yet been done.—ED.]

Mr. Warburton, Mr. Dugdale, Mr. Brotherton, Mr. Aaron Chapman, Mr. Charles Lushington, Sir Eardly Wilmot, Mr. Thornely, Mr. John Young, Mr. Daniel Gaskell, Mr. Foster, Mr. George Evans, constituted the Committee.

MR. WARBURTON reported from the Select Committee to whom several petitions complaining of the names of certain needy and indigent persons having been inserted in the Subscription List of several railways, and praying for inquiry into the case of the Deptford and Dover Railway Subscription List, on which subject the following petitions were particularly referred:

- 1st. The petition of John Chester, David Smith, and Joseph Wright, owners and occupiers of land in the line of the projected Kent railway from Deptford to Dover, complaining of a violation of the Standing Orders of the House:
- 2d. The petition of Richard Spenser and others, who have signed, as they state, the Kent Railway Subscribers' Deed and Parliamentary Contract:
- 3d. The petition of the Directors of the Kent Railway Company, praying to be allowed to meet the allegations contained in the petition above first mentioned:
- 4th. The petition of Frederick George Hamond, gentleman, praying to be allowed to defend himself against the imputations raised against his character in the petitions 1st and 2d above mentioned:

And who were empowered to report their observations, together with the minutes of evidence taken before them from time to time to the House;—that they have taken evidence on the matters adverted to in the said petitions, or having reference thereto, and heard observations on the evidence by the agents and counsel of the parties to the petitions 1st, 3d, and 4th above mentioned, and considered the whole of the premises; and have agreed to the following Report.

Your Committee, before proceeding to offer any observations on the case submitted to their inquiry, beg to state the principal facts of that case which appear to them to stand in evidence.

The project for the formation of a company to obtain an Act for making a line of railway from the present terminus of the Greenwich railway at Deptford, through Gravesend, Rochester, and Canterbury, to Ramsgate and Dover, to be called the Kent Railway, has been so mainly set on foot by the promoters, and sustained by transferring to it the property of three companies projected for making two other lines of railway, the one to be called the Gravesend Railway, and to run from Deptford to Gravesend, the other to be called the Dover Railway, and to run from Gravesend through Maidstone and Folkstone to Dover; that some brief account of the proceedings had for the formation of these three projected companies is necessary to a clear understanding of what regards the Kent Railway Company.

#### *Original Gravesend Railway Company.*

The original Gravesend Railway Company was set on foot by Mr. William Green, one of the present secretaries of the Kent Railway Company, in consultation with some persons connected with the Greenwich Railway. They proceeded to form a board of provisional directors, which met for the first time on the 28th of October, 1834, and on the 19th of November issued a pro-

spectus for the formation of a company, with a capital of 600,000*l.* in 30,000 shares of 20*l.* each; deposit 10*s.* per share.

Very few shares, it appears, in this company were applied for; and not more than about 1,000 were allotted, exclusive of those subscribed for by the officers and directors themselves. The deposits paid amounted to 1,931*l.* 10*s.*, which was nearly all expended by the autumn of 1835.

About this time the plan of a new company, for carrying the same object into effect, having been brought to maturity, it was agreed to dissolve the original company, and to transfer all their papers and surveys, together with the small remaining balance of cash, to the said new company; which, in return, agreed to take upon itself all outstanding claims against the original company, and to give shares in the new subscription to the subscribers to the original company, at the rate of one such share for every pound by them so subscribed.

The dissolution of the original company was completed on the 1st of December, 1835.

For the names of the officers and the directors of this company the Committee beg to refer to the table given in the sequel, which will show how far the promoters of this company were identical with the promoters of the other railway companies hereafter to be noticed.

#### *New Gravesend Railway Company.*

The first meeting of the promoters of the New Gravesend Railway Company was held on the 13th of October, 1835, when a board of provisional directors was appointed, and a prospectus was prepared, agreeing in all essential particulars, as regarded the plan in contemplation, with the prospectus of the original company, except that the deposit per share was raised from 10*s.* to 1*l.* The chairman, the engineer, the solicitor, and the secretary remained the same. New bankers were appointed; some, who were directors of the original company, were not appointed, and some new directors were introduced. For the names of the officers or directors of this company, who were also officers or directors of the original Gravesend, the Dover, or the Kent Railway company, your Committee beg to refer to the table given in the sequel.

The reception of applications for shares was closed the 3d of November; and on the 4th, it being reported by the secretary that nearly 80,000 shares had been applied for, it was resolved, that out of the total number of 30,000 shares, 22,269 should immediately be appropriated to the public, and a Committee was appointed to make the appropriation.

This Committee took considerable pains to distribute shares to such of the applicants as were considered able to pay their deposits; and in selecting parties for refusal, the Committee availed themselves of a list, which the directors paid money for obtaining,

currently known by the name of the Black List, containing a catalogue of persons described as Letter-writing Share-hunters, men who watch for projects coming out, write for shares, and sell the letters of appropriation they obtain for what they can get. The letters, appropriating shares, were sent out on the 6th of November; and the result of the care which had been taken in making the allotment, is stated to have been, that the Parliamentary Subscription Contract of the New Gravesend Railway Company presented a very substantial and *bonâ fide* list of subscribers from beginning to end.

On the 13th of November the deposits paid amounted to 18,600*l.*; and on the 5th of January, 1836, the Board advertised, that the whole of the capital had been subscribed, that the deposits were paid, and that the Standing Orders of both Houses of Parliament had been complied with.

Of the shares appropriated, the following account has been rendered to the Committee by Mr. Green, the secretary:

Shares appropriated to subscribers to the original Gravesend Railway Company .....	1,931
Shares appropriated to the public, pursuant to the Board's Resolution of 4th November, 1835.....	22,269
Shares appropriated to directors .....	2,800
Shares, afterwards distributed, and paid for .....	1,020

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Total..... 28,020

There is a difference between this statement and that given by the same gentleman in 1836 before the Committee on the South-eastern Railway Bill, when he stated that deposits had been paid on 29,401 shares, and this difference has not been explained in the evidence before your Committee.

Prior to the second reading of this Bill in the House, the shares, it is stated, were at a considerable premium; but on the 29th of February, 1836, the Gravesend Railway Bill having been thrown out on the second reading, by a division of 177 to 63, the shares afterwards fell to a less price than could have been returned per share had the project been abandoned, and the balance of cash in hand been divided amongst the shareholders. On the 13th of April this company merged in the Kent Railway Company, under circumstances which will be stated after giving an account of the Dover Railway Company.

#### *Dover Railway Company.*

The origin of the Dover Railway Company, the line of which was to run from Gravesend through Maidstone and Folkstone to Dover, was as follows: On the coming out, at the close of October 1835, of an advertisement, announcing the project of the South-eastern Railway, that project, if carried into effect, appeared to

Lieutenant Brothers and Mr. Walter, Directors of the Gravesend Company, so likely to be injurious to the prospects of the Gravesend Railway Company, that they determined to get up the project of the Dover Railway, as soon as possible; and, assisted by Mr. Green, they drew up an advertisement, announcing the formation of the Dover Company, which was published in the *Dover Chronicle* of the 5th of November 1835. It announced that the line of the railroad had been surveyed; that the estimated capital for the undertaking was one million sterling, to be raised in 20,000 shares of 50*l.* each, the deposit per share being 1*l.*

For the names of the officers or directors of this company, who were also officers or directors of the original or the new Gravesend, or of the Kent Railway Company, your Committee beg to refer to the before-mentioned table.

On the 10th of November, the day on which, pursuant to the advertisement, the application for shares was to close, 1,504 letters of application had been received, applying for 47,480 shares. A Committee was appointed to appropriate shares; which task the Committee executed, not, as was the case in the Gravesend Company, by carefully selecting those applicants who were considered most able to pay their deposits, but by distributing shares to all the applicants, without making any inquiry whatever as to their respectability, and mostly *pro rata*, according to the number of shares they severally applied for. The number of shares thus appropriated out of the total number of 20,000 was 19,407; and on the 13th of November, the day announced by advertisement for that purpose, letters, appropriating that number, were sent out to the different applicants. One consequence of the indiscriminate issue of shares that had been made, soon manifested itself in the sale, by a number of needy and necessitous persons, of the letters they had received, at the rate of 2*d.*, 3*d.*, and 4*d.* a share premium; and another consequence, subsequently, in the fact, that deposits were paid on only 4,848 shares of the 19,407 shares which had been appropriated. A subscription deed, which was deposited in the Private Bill Office, was signed to the amount of 392,350*l.*, representing 7,865 shares; the difference between 4,848 and 7,865 arising, it is stated, from directors paying deposits, not to the extent of their subscriptions, but only on twenty shares, the amount of a director's qualification.

A Petition for a Bill was presented to the House the 19th of February, 1836, but that the Bill was dropped, in consequence of the loss of the Gravesend Bill on the second reading.

On the 13th of April this company merged, as will be hereafter stated, in the Kent Railway Company, though a final board-meeting was held so late as the 10th of June.

The expenditure of the Company from first to last was 2,030*l.*

*Kent Railway Company.*

The Kent Railway originated in the following manner. On the 17th of March, 1836, the Committee on the South-eastern Railway Bill, which was for a line from Croydon to Dover, was named. On the preceding day a Committee of the Directors of the Gravesend Company had been appointed to act in conjunction with a Committee of the Directors of the Dover Company; and on the 18th of March both those companies petitioned to be allowed to appear by counsel as projectors of a competing line, before the Committee on the South-eastern Bill. On or about the 12th of April, while that Bill was yet in Committee, it was determined by the Directors of the two companies to consolidate them into one company, to be called the Kent Railway Company, which determination the directors communicated to the proprietors of the two companies in an address to them, which was published on the 13th of April. It was proposed by a Director of the two companies to call a meeting of the proprietors of the two companies, in order to obtain their sanction to the proposed consolidation; but this proposal was overruled, it being considered, that under the deeds of settlement of the two companies, the Directors had full power to act as they might think best for the interest of the proprietors: and they thought it best for their interest to act as they did. In the address of the 13th, the proprietors of the two companies were informed, that the holders of the scrip certificates of either of those two companies, on which a deposit of 1*l.* per share had been paid, were to have the option, in exchange for two such certificates, of receiving a scrip certificate of the deposit of 2*l.* per share in the proposed new company; and also, that such of them as might wish to obtain a further interest in the new company, should be allowed a preference, in proportion to the number of certificates they might exchange, on making application to that effect on or before the 1st of May; and also, that any proprietor who might prefer to have the deposit already made returned to him, might receive the same, after deducting a proportion of the expenses which had been incurred, so soon as the accounts could be made up and settled (of which notice should be given at the earliest opportunity), provided they expressed such their intention, in writing, to the secretaries on or before the 22d of April instant. No circular to the foregoing effect was sent, it is stated, to the subscribers of the Gravesend and Dover companies; because at this time, when the shares had been bought and sold many times over, the Directors did not know who the parties holding the shares of the original subscribers, and now representing them, really were.

On the 29th of April the Directors came to the following resolution:—"Resolved, That in consequence of Colonel Landmann declining to appear before the Committee of the House of Commons, Mr. Walker be requested, at his earliest convenience, to

make such survey of the country from London to the Kent coast, and the harbours, and every point affecting the facility of a ready communication with the Continent, as may enable him to determine upon and recommend a line embracing, to the greatest extent, the interest of the Government in its various departments, and of the intervening towns and country."

In consequence of this resolution, Mr. Walker, on the 3d of May, had several conferences with the chairman of the company; he declined, he states, at this time to allow his name to come before the public as consulting engineer, or as connected with the line, until he had examined it, and made himself acquainted with its feasibility. He agreed, however, to examine the proposed line of country.

On the 16th of May, the Committee on the South-eastern Railway Bill reported on the proposed line of the Kent Railway, as a competing line to Dover, with the South-eastern:

"That the engineering evidence on the Northern line, or Kent Railway, did not establish a case in detail before your Committee; but it appears to be a line, which, as connecting the port of Ramsgate and other large towns in the north of Kent with London, and showing public advantages, may, for such purposes, entitle it to consideration hereafter, provided it can be shown that such a line may be accomplished without insuperable engineering difficulty; but your Committee do not, for the reasons before stated, consider it eligible as a line from London to Dover."

On the 28th of May, the first prospectus of the Kent Railway, as a line to Ramsgate, was published.

In that prospectus the above-stated opinion of the Committee, respecting the line to Ramsgate, is quoted as the ground for the choice by the Directors of Ramsgate and not Dover, as the terminus of their line. The capital is stated to be 2,000,000*l.*, to be raised in 40,000 shares of 50*l.* each, 2*l.* per share being deposited. Respecting the providing of this capital, it is stated, that the greater part of it has been provided by the arrangement under which the property and interest of the late London and Gravesend, and London and Dover companies, have been transferred to the present enterprise. Then follows an announcement, that as Mr. James Walker has undertaken to complete all the surveys, the subscribers may confide in the selection of the most eligible line, and in the establishment of a case for the ensuing session of Parliament, presenting in every respect the strongest claim to legislative protection and support.

In this prospectus the names of the officers and directors of the company are announced. They were, it is admitted, nearly the same with the persons who were officers and directors of the Gravesend and Dover companies. In proof of this, your Committee refer to the table which is here appended.

	KENT RAILWAY.	DOVER RAILWAY.	NEW GRAVESEND RAILWAY COMPANY.	ORIGINAL GRAVESEND RAILWAY COMPANY.
Directors ..	Lieut.-col. Sir A. Leith Hay, M.P. Charles Perkins, Esq. ... Peter Hesketh Fleetwood, Esq., M.P. Thomas Philpotts, Esq. Wm. Pinney, Esq., M.P. Rowan Ronald, Esq. George Rob. Rowe, M.D. Lieut.-col. Skerrett .... Owen T. Alger, Gent. ... Henry Short, Esq. Wm. Borradaile, Esq. ... John Rodway Stock, Esq. John Brothers, Esq., Lt. R.N. John Twells, Esq. .... Edward Hughes, Esq. Lieut.-col. Utterton .... George Money, Esq. George Walter, Esq. .... Robert Page, Esq. .... John Yeats, Esq. .... T. Lamie Murray, Esq., elected 14 Feb., 1837.	Col. Leith Hay, M.P. .... Charles Perkins, Esq. ... Thomas Philpotts, Esq. Wm. Pinney, Esq., M.P. G. R. Rowe, M.D. .... O. T. Alger, Esq. John Brothers, Esq., Lt. R.N. George Walter, Esq. .... Robert Page, Esq. .... John Yeats, Esq. R. D. Neave, Esq. .... Capt. Henry Jones. .... Alex. M'Dougall, Esq.	Lt.-col. Leith Hay, M.P. Charles Perkins, Esq. ... Peter Hesketh Fleetwood, Esq., M.P. Thomas Philpotts, Esq. G. R. Rowe, M.D. Lieut.-col. Skerrett. Wm. Borradaile, Esq. ... John Brothers, Esq., Lt. R.N. John Twells, Esq. .... Lieut.-col. Utterton George Walter, Esq. .... Robert Page, Esq. .... Rich. Digby Neave, Esq. Capt. Henry Jones. John Moxon, Esq. Jno. Fras. Maubert, Esq. Rob. Sutton, jun., Esq. Newman Smith, Esq. ... Thos. Eyre Wyche, Esq. J. P. Boileau, Esq. S. J. Boileau, Esq.	Charles Perkins, Esq. Wm. Borradaile, Esq. John Brothers, Esq., Lt. R.N. John Twells, Esq. George Walter, Esq. Robert Page, Esq. John Moxon, Esq. Jno. Fras. Maubert, Esq. Rob. Sutton, jun., Esq. Newman Smith, Esq. William Pitcher, Esq. Frederick Scheer, Esq. Jas. Campbell, jun., Esq. Thomas Hamond, Esq. J. Alex. T. Smyth, Esq. James Sutton, Esq. Robert Sutton, Esq. W. T. Beeby, Esq. Abel Rouse Dottin, Esq. Ladbroke and Co. George Smith, as surveyor and architect. James Vallance. William Green. Robert Lancaster, (examiner of a document, p. 8 of Evidence).
Bankers.. {	Spooner, Attwood, & Co.	Spooner, Attwood, & Co.	Spooner, Attwood, & Co.	Ladbroke and Co.
Engineer ..	James Walker, Esq., appointed 1 Nov., 1836..	Col. George Landmann	Col. George Landmann	Col. George Landmann.
Assistant Engineer }	John Herapath.			
Surveyor ..	George Smith .....			George Smith, as surveyor and architect.
Solicitors ..	James Vallance ..... A. H. M'Dougal. Messrs. Currie & Woodgate, (in prospectus, 1 Nov., 1836).	James Vallance .....	James Vallance .....	James Vallance.
Secretaries	William Green ..... Colla Smith .....	Colla Smith.	William Green .....	William Green.
Accountant	Robert Lancaster .....		Robert Lancaster .....	Robert Lancaster, (examiner of a document, p. 8 of Evidence).



The surrender of shares in the two former companies, in exchange for shares in the Kent Railway Company, began on the 27th of June, 1836.

It has been stated already, that there were of Gravesend shares on which deposits were paid, about 28,020; of Dover shares, on which deposits were paid, 4,848; together making a total in the two companies of about 32,868 shares; which, pursuant to the announcement of the 13th of April, might be exchanged for Kent shares. Of these, it is stated that about 6,000 shares have not yet been brought in to be exchanged; leaving about 26,860 shares of the Gravesend and Dover companies, as the number which were actually brought in to be exchanged.

The mode of effecting this exchange is stated to have been as follows: new scrip was given in exchange for old, to any person who brought the old; who, on receiving in exchange the new scrip, was required to sign the deed. In what name, on delivering up the old scrip, a party claimed to have new scrip, was also entered on the certificate cheque-book. No further inquiry was made who the parties exchanging scrip were. Their names were not scheduled.

The number of persons who refused to exchange their shares, and who in pursuance of the announcement of the 13th claimed to receive, and actually did receive back their deposits, was only two; and they held five shares each. One other person only, it is stated, has since made a similar application.

The day at first appointed by the Directors for closing the door to the reception of applications for original Kent shares, was the 2d of May; but to shareholders of the Gravesend and Dover companies, this day was further extended to the 15th of June; and the day at first appointed for sending out letters appropriating shares, was the 15th of June, 1836. The number of letters of application for original shares was, on the 2d of May, 1,158, and the number of such shares then applied for, was 31,491. To the 15th of June, 1836 inclusive, after which no more applications were made, the number of applicants for original shares, was 1,174; and the number of such shares applied for, 31,926; and the number of such shares on that day appropriated, 15,598. The shares were never much in demand, nor did they ever rise to a premium.

To the 17th of February, the number of original shares on which the deposit of 2*l.* per share was paid, was, according to the secretary, Mr. Smith, 1,444, but according to Mr. Lancaster's list, 1,315. On this, Lieut. Brothers, one of the Directors, remarks, "they sent out letters allotting shares to the full amount, reserving a certain portion for parties along the line. Few shares were issued, because few paid. They issued a sufficient number of letters, but between issuing letters and paying deposits, there is a great difference."

*(To be continued.)*

“ROYAL SOCIETY AND MR. HERAPATH.”

[The private correspondence which terminated in the exit, expulsion, or forced retirement of Sir Humphry Davy from the Presidency of the Royal Society.]

(VIII.)

*Bristol, Knowle Hill, November 6, 1820.*

Dear Sir,—In consequence of an accident which happened to one of my best thermometers I have been delayed in making some experiments on heat in a new and still more decisive way, the evidence of whose results I wished to obtain previous to replying to your favour of the 25th ult. At length, however, I am happy to inform you I have perfectly succeeded, and have obtained a new testimony of the accuracy of my views, as well as an experimental confirmation of an important phenomenon, which I had long suspected, but until now have never been able to prove. I feel exceedingly obliged to you for the trouble you have had the goodness to take with my communication, and regret there should have been occasion for it. You say, “that some of the Council think my paper too theoretical for the Transactions.” Now it is by no means my wish to urge anything in opposition to the opinion of these gentlemen, who, I presume, understand matters of this kind better than I do, yet I cannot help thinking, that they have decided a little too hastily on this point. In the first part, or the “Analytical inquiry into the cause of gravitation, heat, &c.,” I have proceeded entirely by combining and analysing phenomena as they have been established, not by any new or doubtful experiments of my own, but by those which have been long known and well attested. After having by this means arrived at the cause of heat, the physical constitution of gaseous bodies, and the laws of the collision of hard bodies, I have demonstrated synthetically, and by mathematical rules, all the laws and phenomena of gases which have yet, I believe, been discovered.\* So far, therefore, I conceive my communication stands on as firm and as experimental a foundation as any other, the object of which is (what I presume the object of all philosophical inquiries ought to be), to investigate the causes by the effects. It is true, that thinking myself entitled by those corroborations of my analysis to push the subject somewhat farther, I have ventured to deduce other laws, and to develop other phenomena that flow from the same principles, without considering myself obliged to go to the expense of confirming them by experiment. But this by no means brings the paper under the charge of the Council. It would have been much more censurable had I seen and omitted these things; and it would have

[\* There was one law easily demonstrable which had been overlooked.—ED.]

besides tended to throw a deep shade of **suspicion** over my own opinion of the subject. However, to put my inquiries to a decisive test, I have, as I have informed you in a former letter, tried some experiments which I conceive to be perfectly conclusive; and the rest which I may have hinted at as well as some others I shall undertake as soon as I shall be more settled than I am at present.

After having unfolded the laws of heat and gaseous bodies I have applied my principles to the opinion of the great Newton, respecting the cause of gravitation, and have afterwards extended them thus reinforced to the causes of a great variety of phenomena, which have hitherto baffled all investigation. Could any part of my paper be called hypothetical it is possibly this. Even here, however, I might have supported myself by the same analysis of phenomena as in the laws of gases, had I not been influenced with a desire of being as brief as possible. But, should this part be objected to, I beg leave to observe that I apprehend I am fully justified in having introduced it, not only on account of the acknowledged importance of the subject itself and of the beautiful consequences which flow from it, nor on account of its having been the hitherto undemonstrated opinion of the greatest philosopher which England has produced on the most important part of the universe, but on account of its having being some years back strongly recommended by the Royal Society itself to the consideration of mathematicians, and on account of its having in consequence of that very recommendation engaged the attention of some of the ablest philosophers, both at home and abroad.

Were I disposed to carry on arguments in defence of my communication, I might easily show that the object of the Royal Society, with respect to investigating the cause of gravitation can never be accomplished, but by relying on the facts already established; that for perfecting the investigation we are in possession of sufficient, and have no necessity for any new ones; that the memoir in question will not be found more theoretical than many valuable ones that have obtained a place in the Transactions, not more so for example than some of the earlier papers of the illustrious Newton, which, in respect of theoretical tendency, differ from mine in this only, that he has conducted his analysis chiefly on his own experiments, and I mine, because no new ones were wanted, on other people's. It is, however, not my intention to urge this business any further. I have no desire to press any production of mine on the Royal Society contrary to the sentiments of their Council. My only design has been to show that the idea of theoretical, or rather what I conceive is implied, the idea of hypothetical, cannot with propriety be attached to this paper, which is nothing more than a mathematical analysis and synthesis of phenomena, and which at the most can only be charged with not containing any new experiments.

I now beg leave to observe, that my principal motive for pre-

sending this paper to the Royal Society originated in a profound respect for that learned body, and from a belief that a communication of this kind would not be unacceptable. If, however, I have formed a too favourable opinion of my own labours, I have deceived myself. But should it be, that the Council see defects which more than balance those allowances which the difficulty of the subject demands, and think it, therefore, necessary to reject the paper *in toto* on account of the partial failing of its author, and to withhold from him that kind protection and encouragement in the prosecution of his researches, which he had hoped the trouble, at least, he had been at, would have procured him, there will evidently be no other means for him to obviate that unfavourable impression in the minds of his friends, which the tacit judgment of the Council must naturally produce, but to come before the public on his own strength, and rely on his own efforts, and the kindness of those who may support him, for that protection and patronage of which the Council has not thought his labours deserving.

I feel much obliged by your offer of laying the paper before the new President and Council, but if there be no probability of its appearing in the Transactions, I should beg to decline the honour of its being read. Nevertheless, if you think it advisable I will await their opinion, but until I hear something farther of their sentiments it will, I presume, be an unnecessary trouble to you and myself to send up the experiments.

In whatever way the new Council may think proper to decide, I should feel much obliged, if not too troublesome, to be early acquainted with it, and as I am coming to reside within a few miles of London after Christmas, I should be glad if you would keep the memoir until then, should the new Council be also determined to reject it. I am, dear Sir, very respectfully, your obedient humble servant,

(Signed)

JOHN HERAPATH.

To Davies Gilbert, Esq., M.P.

(IX.)

*Knowle Hill, Bristol, Dec. 9, 1820.*

Sir,—Finding you are elected President of the Royal Society, I beg to take the liberty of soliciting your attention to a subject, on which I expect you will shortly be called, in conjunction with the new Council, to form an opinion. My only motive for thus troubling you is, that by a little anticipation of the nature and circumstances of the thing, you may be better prepared to give it a more serious consideration than perhaps you otherwise would.

The subject to which I allude, is a mathematical investigation of the causes, laws, and phenomena of heat, gravitation, gaseous elasticity, &c., contained in a memoir which is now in the hands of Davies Gilbert, Esq., the Treasurer, and which I sent him several months since, for the purpose of being laid before the Royal Society. About a fortnight after I had sent it I

received a letter from Mr. Gilbert, stating, "that he had read it, and put it before two of the best mathematicians in London, who opposed its being laid before the Royal Society, because they had some doubts of the truth of the conclusions I had drawn!" Now, though I very much suspected that it was not in the power of these gentlemen, in so short a time, and amidst, probably, a multitude of other affairs, separately to read and make themselves masters of a paper of the length and nature of the one I had sent; yet, rather than call in question their opinion, I determined to undertake some experiments\* on temperature, which I knew would be decisive the one way or the other. As soon as I had tried two or three, and found the results perfectly accord with a formula that I had previously given in the memoir, I informed Mr. Gilbert of it. In reply to this letter, that gentleman, some weeks after, had the goodness to inform me that he had now laid the communication "before some members of the Council, usually looked up to in such cases, and that they thought it too theoretical for the Transactions;" but, that if I wished, he would await the election of a new President and Council, whose opinion he would take upon it.

This, Sir, is a brief outline of the circumstances, with respect to my paper, as they now stand between me and the Royal Society, on which I am not disposed to make any observations that may in the least tend to prejudice or influence your judgment. In justice, however, to myself, I must beg leave to observe, that the charge of theoretical, in the sense in which I conceive it is meant, is by no means correct; that the paper is founded on a laborious analysis of phenomena, which I have given in detail, without any attempt to conceal even the errors into which I had fallen; and that it is, therefore, saying nothing of my own experiments, not more theoretical than all communications must inevitably be, which have for their object the development of causes from effects. I must also beg leave to observe, that, in presenting this paper to the Royal Society, I was actuated by a desire to evince my respect for that learned body; and by a wish to present them with the first fruits of an investigation, which, some years ago, they so forcibly recommended to the consideration of mathematicians, and in which I therefore imagined they would take a lively interest. But had I been aware that such a course would have been displeasing to any of the members of the Royal Society, I would on no account have taken it. Since, however, it is now known to many of my friends, and to a number of respectable individuals in this city, that I have

\* These experiments do not accompany the memoir; they were, in fact, not in existence when it was sent, but have been made since. Their object is to determine whether the increments of temperature in gases are proportional to the increments of volumes. I find this is not the case, but that the temperatures, *cæteris paribus*, are, in the subduplicate ratio of the volumes, the same as my analysis gives it.

sent a paper of such a description to the Royal Society, I must bring the subject before the public in some way, if it be only to endeavour to extricate my scientific pretensions from that cloud of significant suspicion, in which the opinion of the late Council has involved them.

Allow me now to say, that I feel exceedingly happy that you are elected to the chair of the Royal Society, not because I expect from you any favour or partiality in this affair, for I have not even the advantage of being known to you; but because your ideas of heat, and the physical constitution of things, coinciding with those I have developed in the above-mentioned memoir, you will come to the subject with a mind clear and unprejudiced with any extraneous hypotheses, and will, therefore, I hope, cause the paper to receive that attention which the importance of the subject requires. Many imperfections, I have no doubt, you will perceive in the executive part; but, however much they may detract from the merit of the memoir, I flatter myself you will not discover in it any glaring proofs of inability, or of a mind disposed to whimsical or visionary hypotheses. Should the subject come before you, I hope and trust the ordeal will be severe; and if, as I have informed Mr. Gilbert, my views or arguments can be refuted, or can be shown to be unsupported by facts; or if any fundamental inaccuracies can be discovered in the mathematical inductions, I shall feel no hesitation in abandoning the principles I have adopted, notwithstanding the extensive variety of phenomena which they explain, and the weight they must derive from their coincidence with the views of Newton and yourself. Until, however, something of this kind can be done, I shall presume to think that my investigations are unrefuted; and shall conceive myself justified in applying, to any such objections as have been made, the motto of the Royal Society, "Nullius in Verba."

Should you be inclined to honour this letter with a reply, after you have considered the paper, I shall feel exceedingly obliged; and beg to inform you, that until the 21st inst. I shall be at my present residence, at Knowle Hill, Bristol; and from thence, until about the 5th or 6th of January, at Messrs. Moore, Adlam, and Co.'s, Broad Weir, Bristol; but afterwards, at Cranford, near London.

I am, Sir, very respectfully,

Your obedient humble servant,

(Signed)

JOHN HERAPATH.

To Sir Humphry Davy, Bart.

(To be continued.)

## SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

*Comparative Value of Apples to feed Stock, and for Sale, and their products, Cider and Brandy.*—(From the "Farmer's Register.")—During the two last summers and falls, my duties called me into the apple regions of the north. The following facts were obtained in reference to the subject of apple, cider, and brandy :—

1. Cider drinkers are peculiarly subject to rheumatism, to inflamed eyelids, to headache, bleeding at the nose, to sores and ulcers difficult and tedious to cure, to affections of the stomach and bowels, and to premature trembling of the hand and head.

2. Cider drunkards are the most brutish and cruel of the unhappy tribe of inebriates.

3. An old orchard and a distillery, are almost invariably indices of widows, orphans, poverty, and drunkenness.

4. There is a great loss of money in making either cider or brandy. Good eating apples are worth, on an average, 25 cents per bushel. Eight bushels of apples make a barrel of cider, and twelve barrels of cider make one barrel of brandy. Brandy at 50 cents per gallon, would give about 15 cents per bushel for the apples. The loss is 10 cents per bushel. This, on an orchard of 100 trees, in ten years, would be over 1,000 dollars! No allowance is made for capital and labour connected with distilling. Take these into consideration, and the loss is much greater.

5. It costs no more to raise good apples suitable for market, than to raise apples only suitable for distilling. Very often apples are worth one dollar per bushel, and then the loss is immense by turning them into brandy. I am told that in Mobile, apples sell now for 10 dollars per barrel.

6. Engrafting and budding will change the character of an orchard, and more than compensate for the time and amount lost in producing the change, in ten years.

7. Apples make most excellent food for horses. Several physicians of extensive practice, in Connecticut and Massachusetts, feed their horses on apples and hay. I have never seen fatter horses, more sleek, and spirited. The hair much more lively, and requires less grooming than that of horses fed on grain. Mr. Norton, of Larmington, Connecticut, has about the finest pair of horses I have seen. They are fed mainly on apples and hay. They travel very fast, and seem to have both wind and bottom. It is proper, however, to remark, that not so much grain is given to horses at the north, as is customary at the south. One thing is worth noticing. Horses fed on apples do not eat as much hay as when they are fed on grain. Very sour raw apples injure the teeth of horses; but when boiled, they do not. The rule of feeding is to

commence with a small quantity, and gradually increase it to a bushel a-day for one horse.

8. Apples are most excellent food for beeves (bullocks). The fattest beef I have seen, was made so on sweet apples.

9. Nothing will fatten mutton quicker than apples. It is necessary, or best, to cut up the apples when given to sheep.

10. Hogs care nothing for corn if they can get apples: if sweet, the apples may be given without boiling; if sour, they must be boiled. Mixed with corn meal, the flesh is firmer.

11. Apples increase the quantity and quality of milk. At first there was a prejudice against giving apples to milch cows, because it was thought they diminished or dried up the milk. It is true that a *gorge* of apples or any green food, will cause a fever, and dry up the milk; but given in proper quantities, the effect is quite different.

12. Cattle and hogs are purchased, and fattened on apples, and sold at a fine profit; when to fatten them on corn, would insure a loss.

13. Sweet apples, and good eating apples, are to be preferred as food for horses, sheep, and cows; also for hogs, though some recommend a mixture of sour and sweet for hogs.

If these remarks shall induce any one to test their correctness, by making a fair experiment, the object of my writing them will be fully answered.—THOMAS V. HUNT.

*Mortality of Paris.*—Out of every fifteen males, from the age of 18 to 30, which die throughout all France, it has been lately ascertained, one dies in Paris; but with respect to females, it is only one out of every nineteen.

*Preservation of Bodies by Injection.*—A method is professed to have been discovered in France, by which bodies may be made to mummify in the hottest weather, without disengaging the least fetid odour. The only odour they are said to exhale is that of ascetic acid.

*Steam-Vessels.*—M. Verdril says he thinks he has found out a method of impelling steam-vessels without the employment of exterior wheels. This is precisely what is wanting for the introduction of steam navigation on canals.

*Gas to Inflate the Vauxhall Balloon.*—Mr. Green computes that one inflation of this enormous machine would consume gas enough to supply a common argand gas-light four hours every night (Sundays included), for twelve years. Mr. Green has lately sent a letter to the papers, in which he very candidly disclaims some of the extravagant notions set forth by others, of the buoyant power of this stupendous machine.

*Figure of Clouds over the Earth.*—A curious meteorological phenomenon has been related by this celebrated aeronaut. He says that when a body of cloud is floating over the earth at a moderate height, but so as not to rest on it, it takes very nearly



the figure of the earth as to its inequalities. So that when he is above such a body of cloud, and out of sight of terra firma, he can generally tell whether he is over hill or dale. This is a somewhat difficult phenomena to account for; but it is partially borne out by the well-known fact, that though the quantity of rain for any one spot diminishes notably as we ascend, yet in adjacent hills and vales, the quantities are sensibly the same for any given height above either.

*Ready Copyist.*—We formerly alluded to Mr. Lanet's copying machine. A report of it has lately been made, by which it appears that the whole material consists in a little roller press, a moistener, a thin leaf of metal, a varnished cloth, a pencil, and a flagon of ink and powder, which may be contained in an apparatus eighteen inches long, twelve broad, and a few thick. An ink strongly hygrometric to write the originals with, and a similar powder to take the copies with, constitute the base of the invention. To use the apparatus, we begin by compressing the original, by aid of the press, against a piece of the varnished cloth. A counter proof thus obtained on the cloth by the transport of part of the ink of the original, is strewed over with the hygrometric powder for taking off the copy. The original will in this way furnish many counter proofs, and after it has become faint from the successive abstractions, may be restored to its primitive tint by a little of the powder, which preserves to the original the indelibility of the copies. The base of the powder is Indian ink. One may moisten the writing by simply blowing his breath on it; but Mr. Lanet has contrived a neat little apparatus for the purpose. Some high compliments have been paid to Lanet by the Commissioners who have examined the invention, and witnessed his dexterity in applying it either to taking copies of the whole, or any part of a MS.

*Effects of Cultivation on Climate.*—We have always been taught to believe that a country becomes warmer as it is more cleared of woods and better cultivated. In some parts of America, Montreal, for instance, the contrary has appeared. (See No. 13, p. 170.) Latterly M. Devize de Chabriot has proved the same by historical documents, with respect to Saint Flour, in France. He shows that on the hill of Saint Flour, where the vine flourished in the 13th and 14th centuries, it will not now grow: that in many cantons where the chestnut-tree formerly grew, it has now disappeared; and that numerous villages on the summits of hills have been abandoned. Similar effects have been produced on rivers by the clearing of wood-lands, and many ancient sources have been dried up.

*Effects of Wood-land on Rain.*—To the above testimony respecting rivers, M. Boussingault has added others much less equivocal. He has gone much farther, and shown that the clearing of wood-lands actually diminishes the quantity of rain.

*Fossils of Gigantic Animals.*—There has lately been found at Louisiana, the fossil head of an animal of the cetaceous kind, whose head, which appears complete, is 18 feet long, and 7 feet broad. It was found 25 yards deep, in a soil whose nature is not mentioned.

*Zinc for covering great Edifices.*—It has been lately shown in France, that the objections apprehended in the case of fires where buildings have been covered with zinc, from its combustibility, are groundless.

*Incrustation of Boilers.*—M. Chaix de Maurice, who has invented a method of preventing the incrustation of boilers, asserts that his method is so well established by numerous experiments, that he shall claim to contend for the prize founded by M. Montyon, in favour of discoveries useful to humanity.

*New Magnetic Apparatus.*—A French artist, of the name of Billant, has contrived an apparatus, founded on the experiments of Dr. Faraday and Mr. Clarke, which is said to produce much stronger magnets than those usually employed. His method has not yet been made public.

*Sudden Subsidence of a large Portion of Earth.*—On the 22d of December last, near Waben, a portion of land, 120 feet in circumference sank suddenly, making a large hole 45 feet deep, which soon about half filled with water.

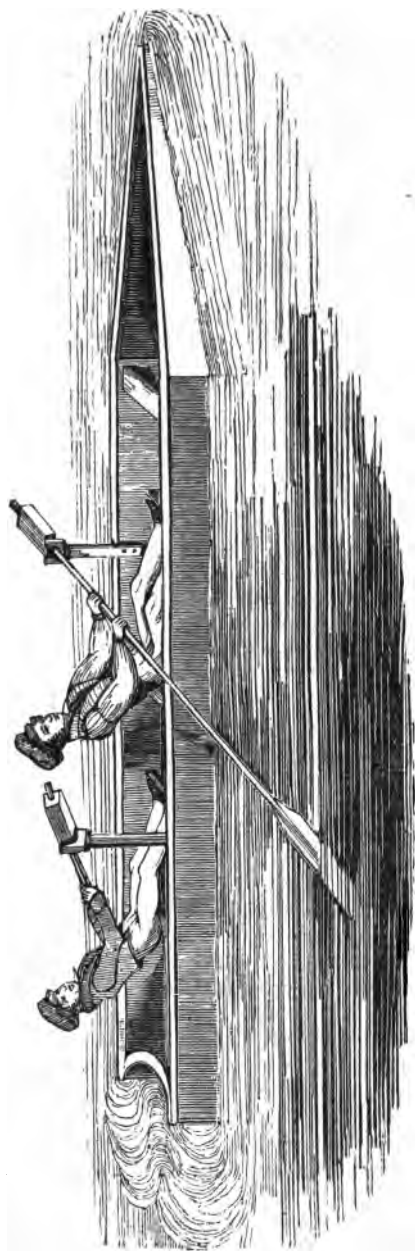
*Force of Steam in the Boiler and Cylinder.*—It will be remembered by our readers that we have repeatedly insisted, both from experiment and theory, that there is often a great difference, especially in rapid motions, between the force of steam in the boiler and cylinder, and that this is owing to the throttling of the steam in its passage through the steam-pipe. This we particularly pointed out in our 11th No., and explained by it some curious anomalies in the action of locomotives. M. Pambour held a different opinion. In a discussion, however, lately carried on between him, M. de Champeaux, and M. Morin, he admits that there is often a notable difference between the two pressures. We wish those who have the means and opportunities would institute some experiments on this subject; it would repay them for their trouble.

*Coldness of the Season.*—According to observations collected by M. Arago, April, taking the whole month together, has not been so cold since 1785, or for 52 years. In not one (the coldest was 1809) of the ten cold seasons he has named is the mean temperature of April so low by  $1\frac{1}{2}^{\circ}$  Fahr. Both the maximum and minimum temperatures have been among the lowest, and though the quantity of rain fallen has been about a medium, the number of rainy days have been only few.

*Gas from Resin.*—It has been ascertained by experiments, that five cubic feet of gas from resin gave as much light as nine from oil gas. Respecting the products of combustion, or the purity of the gases, the advantages in favour of gas from resin are incontestable.—*Mining Journal.*

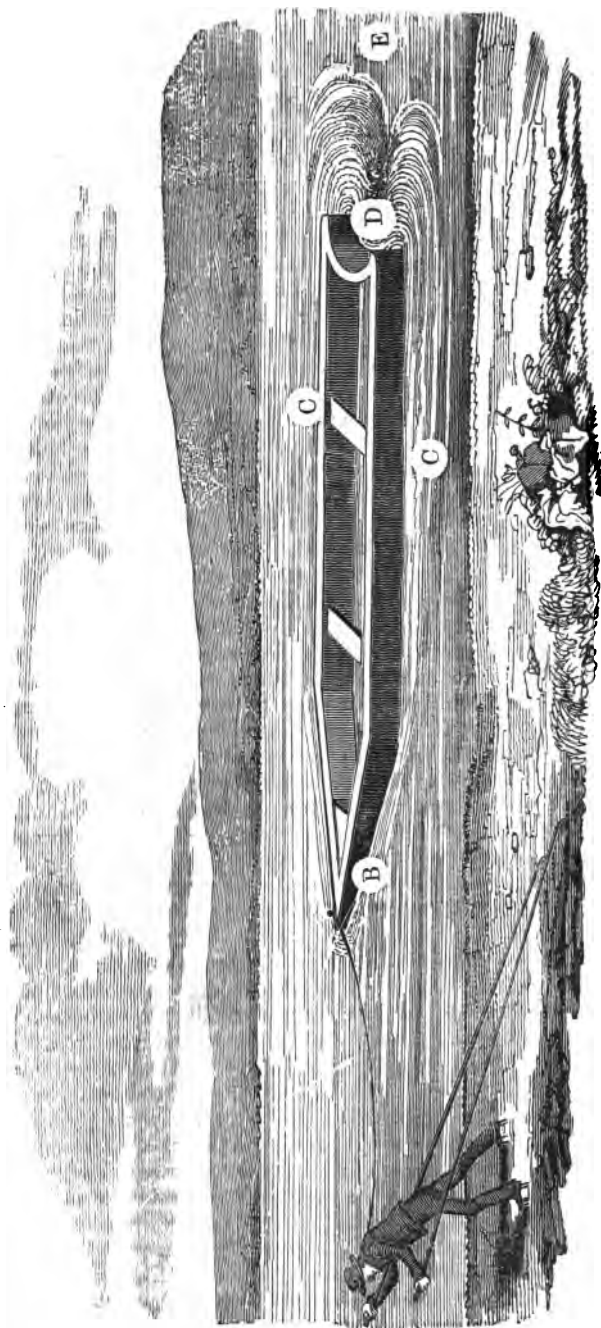
## GOMPERTZ'S BOAT.

*Plate 1.*



THE above plate is a representation of the Gompertz's boat, described in our ninth number, page 376, which goes forward while the rowers pull backwards as usual. The shape of the boat in the plate being also, according to the inventor's ideas, more favourable to speed than the shapes commonly adopted, for reasons explained in page 377.

# GOMPERTZ'S BOAT.—Plate 2.



The above plate is a representation of Gompertz's figure for vessels, in order to increase their speed. Here are shown the different streams. B is the hill or swell of waters in front. C is the same water as the vessel passes it, or as it meets the vessel; and D is the meeting of the two streams from each side of the vessel, where these two currents turn against the back of the vessel and press it on, and behind this is the back water: E following it up, both of which are continually falling into the chasm the vessel is leaving behind it.—It remains to observe that the rudders of such vessels should be so contrived as not to impede the returning streams, and for this purpose, they ought not to act on the water immediately contiguous to the back of the vessel, but ought to have a vacancy for the streams to pass. The rudder in this case being a sort of short broad oar behind the vessel, and worked in the common way.

## REVIEW OF BOOKS.

*Essays on the Principles of Charitable Institutions; being an Attempt to ascertain what are the Plans best adapted to Improve the Physical and Moral Condition of the Lower Orders in England.*

—(Second notice.)—We return with increased satisfaction to state the contents of this seasonable publication. It is founded upon that charity which searcheth out the truth. There is a charity which contents itself in mere giving, but inquires not into the character of those the donor intends to aid. It is often, therefore, applied to support idleness, to encourage imposture, and to deprive the humble and deserving of the relief to which they are entitled. The design of the publication we are examining, is to correct this practice, and to give a right direction to those who wish to assist the deserving. Theory is not attempted, facts are adduced; from them correct inferences are drawn. Investigation is employed with candour, and freed from political or sectarian bias. The method adopted is by essays, of which nine are contained in the present volume. The introductory one states the sources whence the statements have been derived. The second enumerates the external causes of poverty incidental to the progressive state of society. The third specifies such causes as affect particular classes of the community; under which are mentioned war, monopolies, the introduction of machinery, the enclosure of waste land, and other circumstances that influence the rate of wages. The fourth and fifth contain an inquiry into the moral causes that produce poverty; under these, what may be considered blameless misfortune, is introduced, with the remedies for its removal. The sixth enumerates different eleemosynary charities, and the seventh contains the important question, How may charity be properly administered? The two following essays point out various plans for assisting the poor to husband their own resources, and thus diminish, if not remove, the general causes of poverty. We prefer presenting this outline of the contents of this publication, in order to enable our readers most fully to comprehend the importance of the topics, to giving any particular remarks of our own. We wish to lead others to think, and to judge for themselves, and not to trust to the opinions of those who assume the office of guides. A specimen of the style may be adduced from page 185: "In all the cities and principal towns in England, beggars live in the most profligate manner; after having perambulated their circuit, they resort at night to disreputable lodgings, and regale themselves with hot suppers and liquors." Page 188: "It would be useless to multiply proofs of imposture, unless the kind-hearted public will search into facts already proved by Parliamentary examinations, especially in the inquiry into mendicity, which took place in 1815, when it was ascertained that not one in 100 of common beggars are really distressed objects. This has not merely been confirmed, by policemen

and magistrates, but also by the compassionate visitors of the *Strangers' Friend*, and the *Spitalfields Benevolent Society*." Such statements are entitled to mature consideration; and we cannot refrain from warmly recommending them to our readers; and at the same time hoping soon to be favoured with the second volume, which is announced at the conclusion of the one now before us.

*Memorials of Two Sisters*; 12mo. Printed by Seeley and Co. — We rejoice to see this republication, which has already gone through two editions. Its contents will be found peculiarly interesting to such readers, as delight to trace the power of religion, and to mark the consolation it affords, on a bed of sickness, and the triumph it confers in a dying hour. The preface is from the authoress of the "*Aids to Developement*." The subjects discussed display the deep seriousness of the writers, and their earnest solicitude to adorn the doctrines they embraced. We shall not enter into a lengthened detail; but as the former editions appeared before the commencement of our Magazine, we deemed it proper to inform our readers of the reappearance of a work, which was out of print, and the estimate in which it has been held has been shown by the call for its republication.

*The Life of Bishop Jebb*. By the Rev. J. Forster. Two Vols.— Biography, when properly executed, presents one of the most pleasing, interesting, and instructive subjects for contemplation. It exercises thought, whilst it develops character. It shows the connexion of a part, with the whole of a life. It delineates the bearing of a leading motive on the general conduct of the agent. To a reflective reader such a production must be attended with beneficial effects. Of this description is the work which heads this article. It presents, in a clear and affectionate form, the life of one of the greatest ornaments of literature, especially of biblical research. It displays the amiableness of the man, with the graces of the Christian. It combines private excellence with public virtue. It unites the affection of the friend, with the firmness of the patriot. Seldom have we perused a publication with such uninterrupted pleasure. Its authenticity is proved by the sources from which the materials have been collected. They consist of an autobiography, of the letters of friends, and of testimonies from public statements, independent of the observations of the author himself, who was the chaplain of the Bishop, his intimate friend, and for many years his constant companion. Who so fitted to record a life, from which the scholar, the Christian instructor, and the senator might derive benefit? Such is the production we are reviewing. It is divided into the early life of the Bishop, the time in which he was a parish priest, and his appointment to the see of Limerick. The style is correct, and elucidated by interesting anecdotes, and judicious criticisms. There is a pathetic simplicity in many of the passages which relate the sufferings, the patience, the cheerfulness, and resignation of the venerable prelate, that mark

the depth of feeling with which they were recorded. Many such might be quoted; but we prefer recommending the whole to the selection of particular parts, assured that we shall afford an agreeable entertainment to those by whom they are perused.

*Fisher's Views of the Holy Land.*—We have at length before us the first volume of this elegant and much-admired work. Of the views and style of execution we have more than once given an opinion. We have only to add, that the plates and subjects of the latter numbers fully sustain the credit of the preceding, and present a good guarantee that the pledge of the publishers will be redeemed, namely, that “the forthcoming volumes will increase in beauty and interest.”

*Warming and Ventilation.* By C. J. Richardson, architect, illustrated with eighteen zinc plates. Weale, 59, High Holborn.—The object of this treatise “is intended to show (principally through the medium of plates) the means of giving warmth and ventilation, not only to the palace and public building, but the private dwelling of the gentleman, and the workshop of the artisan.” We do not presume to decide between the various methods that have been proposed, but Mr. Richardson having discussed them with much candour, gives the preference to Mr. Perkins’s, by “heated water circulation.” For the reasons and arguments we must refer our readers to the work itself, which is well worth their perusal.

*A Diagnosis of Diseases; or, a Bedside Companion.* By Dr. Cowan, of Reading.—We hail with gratitude every publication that is calculated to remove from our countrymen the censure conveyed in the last “Foreign Quarterly Review,” of the comparative state of the French and English schools in medicine. The superiority of the former we admit, in order to stimulate our brethren to adopt similar methods for improving a science calculated to diminish human suffering, and to advance individual comfort. Though Dr. Cowan’s publication is small, it abounds in useful information to the medical student. We are indebted to him also for an excellent translation of the celebrated work of Louis on phthisis, accompanied by many valuable notes, the result of his own experience. It is from the judicious application of the stethoscope and percussion with auscultation, that important information may be obtained of the source of internal diseases. To the publications just mentioned, as well as to Dr. Latham’s, on the same subject, we recommend the attention of our readers.

*Letters to a Member of the Society of Friends.* By a Clergyman of the Church of England. Darton and Son, Holborn Hill.—During the last century a work appeared entitled “Peace and Union.” It was the production of one of the Members of the University of Cambridge. The consequence to himself was the loss of his fellowship, and final removal from Alma Mater. Of a similar character is the production we are noticing. It is occa-

sioned by a division among a sect long distinguished for an apparent agreement in religious opinions. This seems to have arisen more from want of investigation than from a clear understanding of the principles espoused. To bring the Society to a better knowledge of what they professed to believe, one of their ministers published a work entitled "The Beacon." This was approved by some of the Friends, and by others, charged with supporting erroneous opinions. The consequence was controversy, and the result a secession of many from the Society. A clergyman of the Church of England seizes the occasion to endeavour to convince the Society of Friends that they have departed from the doctrines of their early advocates, as well as from Scripture, on which the Established Church rests for its defence. The writer is skilled in ecclesiastical lore, and discusses the subject with stating the authorities, to which he appeals in a fair and candid manner. He at least shows himself a firm adherent to the community to which he belongs, though by no means according with many of the writers who advocate the same cause with himself. The work is to appear in separate numbers; two have been published. The first, on the principles of Quakers, and their connexion with those professed by other sects, and by the Church. The second, on Baptism. A third is announced on the Lord's Supper. As the subject is likely to excite considerable attention in the religious world, we shall occasionally note its progress; and, with the mention of the contents of the numbers, perhaps make some remarks upon the arguments advanced. Truth is the end we wish to pursue. With bigotry and intolerance we have no alliance.

*Quackery: its Danger, Irrationality, and Injustice; the Causes of its Success, and the best Means for its Suppression: addressed to all Classes.*—We have perused a pamphlet bearing the above title with peculiar pleasure. The writer's name does not appear. It was printed in Bath, where the effects of empiricism are amply displayed. The arguments employed are stated in a cogent form, and are divided into the irrationality and immorality of quackery; and the pernicious effects resulting to the community from the sanction Government affords to its continuance. One specimen of the reasoning of the author shall be given, from p. 6:—"The bare idea of one remedy curing all diseases is a libel on common sense, and would be considered so by all; did not our wishes and prejudices interfere. What would be thought of the individual who advertised that he had discovered something, which, if put into a watch, would rectify all imaginary deficiencies; mend main-springs, supply broken cogs, lost axles, renew worn out wheels, and make the hands, on whatever cause their irregularity might depend, keep proper time! He would, I believe, gain little more than ridicule for his pretended discovery, though, in the abstract, all would agree that such a remedy, were it possible, would be desirable. We should naturally remark, that what would supply one de-



iciency, could not rectify another of a totally opposite direction, and the suggestions of common sense would protect our watches from becoming the victims of either a knave or a fool. But what more manifest absurdity is there in the pretensions of the spurious watchmaker than in those we have alluded to? In the one, the attempt outrages Providence, by abusing the rational faculties mercifully provided for us; while, in the other, we become unthinkingly its victim, because it assails our wishes, and is fraught with a hope, opposed by the least rational reflection." The author concludes with an appeal to medical professors, to join in a petition to the Legislature, to suppress quackery. Whether his proposal will be adopted, or the Chancellor of the Exchequer be disposed to part with the source of revenue thence arising, time will show. The perusal, however, of the pamphlet we warmly recommend.

*Reasons for abiding in the Established Church.* By the Rev. J. D'Arcy Sirr.—This publication was occasioned by the resignation of the Rev. C. Hargrove, of the living of Kilmenas, and assigning the cause of his joining those who separate from the Church established by law. The reply is conducted in general with affection, but with a zeal not always according to history. We refer especially to the account the author has given of the exclusion of 2,000 clergymen by the Act of Uniformity. The cause and effect of that measure are too well known in this country, whatever may be the case in Ireland, to be slightly passed over, or misrepresented. As the controversy has excited great attention, we deemed it worthy of mention, though we prefer the introduction of subjects which tend to preserve the unity of the Church in the bonds of peace and brotherly love. We admire the manner in which the work is concluded, and recommend the perusal of pp. 161 and 162 to every religious disputant.

*The Evangelical Rambler*, 2 vols. Westley and Davis.—Of the good intention of the author of these volumes we have no doubt. There is, however, a want of discrimination in the drawing of characters, and a similarity in the mode in which different topics are discussed, which would confirm what, in page 560 of the 2d vol., the writer himself states:—"The papers are unequal in point of interest and execution, and if we were disposed to advance an excuse, which the kindness of friends would admit, we should allude to his other engagements, which not only consumed his time, but exhausted the energy of his mind." After this candid confession a critical investigation would be superfluous.

*The Banks of Jordan.* Darton and Harvey.—A small but interesting book; well calculated to excite young persons to prepare for early death, and to administer consolation to parents under afflictive bereavements. The selection contains, besides the statements of many striking proofs of the benefit of religious instruction, some original pieces, both in prose and verse, well deserving a candid perusal.

## RAILWAY NOTICES.

*Brighton Railways.*—These lines are still in Committee. A union has been formed between the direct Brighton, Rennie's, and the South-eastern Brighton. We sincerely wish they would all do so. Petition against petition have been presented by parties connected with one against the other, and now they are all got into "Warburton's dissecting-room," or "Railway cess-pool," as it is sometimes called, to have their subscription deeds sifted. Near 300,000*l.* have already been spent in the two sessions on these lines. Is Parliament doing right to permit such immense sums of private individuals' money to be squandered for merely obtaining their sanction, which is, after all, only a yes or no; and is as likely to be given to the worst as to the best line? On the 23d of May, a division took place in Committee, on the report of the Brighton Bills, in favour of Rennie's, by 20 to 7. As far as the Committee of the Commons, therefore, is concerned, Rennie's is the favourite. Mills seems to have been lucky in not having come into the House, and will have saved his money for next session, for we apprehend that will be the result. The Committee have made their report on these lines, and recommended Rennie's to the House for adoption. They have sat thirty-five days and have had nineteen divisions, seven of which happened in the last day. The Report is to be taken into consideration on the 30th of May. Notwithstanding the decision, Stephenson and Gibbs have severally petitioned the House to refer back their Bills to be heard before the Committee on the clauses; and the petitions will be considered on the 30th of May.

*Birmingham Railway.*—The day is not yet fixed, but within a very few weeks about 25 miles of the London end of this line, we understand, will be opened, and about 30 from Birmingham to Rugby. Twelve thousand men are now employed on the works. Saturday nights, we presume, must make *conspicuous figures* in their cash-book.

*Bolton and Preston Line of Railway.*—This is a competing line to the North Union Railway, with which it runs parallel for 12 miles. The traffic which calls for it does not exceed 7,000*l.* per annum, gross. The cost will be 600,000*l.* A line might be obtained to join the North Union, 10 miles south of Preston, that would answer all the purposes required, avoiding all the engineering difficulties, and saving upwards of 400,000*l.* The Bill has been severely contested, and is still in Committee, where it has been for about six weeks.

*Dublin and Kingstown Railroad.*—On the 13th instant, the works, which have been long in progress, for extending the railroad from Salthill station to the newly-completed quay at the angle of Victoria-square, Kingstown, were completed. The new terminus

presents a strong contrast to the former one, and will prove beneficial to travellers returning from, or proceeding to, England.

*Eastern Counties Railway.*—In our last we stated, from one of the papers, that 500 men were employed on this line. We have since seen an account, which we have no doubt is an authorized one, stating that the works in progress were the bridge over the Lea, and the Stratford viaduct. If this be all, the probability is that not 100, perhaps not 50 men were then employed, a vast number, indeed, for such a line, 10 months after having obtained the Act!

We have lately seen the agreement (not bond) entered into by six of the Directors with Lord Petre. We do not pretend to be deeply versed in the law, but it appears to us to be one of the clearest and firmest agreements we have ever seen, binding the Directors not merely in their public but in their *private* capacity; and, as far as we can understand it, to the full extent of their several estates. The case, in our judgment, is no more analogous to Lord Howden's and the North Midland, than a marriage settlement is to a pauper's pass. Did not the Eastern Counties, about six months ago, give Lord Petre notice of their intention to summon a jury to assess the damages; how is it then, with so great a hurry to begin, if their case is clear, that they have allowed the injunction to remain for five months undissolved?

*Mr. Robertson's Action against Mr. Wyld, the Publisher of the "Railway Magazine."*—About the spring of 1836, Mr. Robertson commenced a series of unprovoked and virulent attacks on the Editor of this Magazine, which he continued almost weekly for several months, in the little periodical he edits. Of these we never took the slightest notice, but latterly, having felt it needful on public grounds to make some remarks, which we intended for the good of the Company, on their proceedings, and some of which remarks naturally enough pressed on him as the secretary, we were again assailed with threefold fury from his little battery. We, however, proceeded straight forward with our well-intended observations, when all at once, after exhausting his arts and abuse, Mr. Robertson turned off from the pen, with which unprovoked he had began, to the law, and commenced an action against the unoffending publisher, though the name of the Editor stands prominently forward on the wrapper. In addition to all this, Mr. R.'s solicitor wrote to every agent of the work, making similar threats. The object is, of course, apparent, but we think it will signally fail. We have too much respect for the laws of our country to make any observations on the conduct of Mr. Robertson while the cause is pending. But we have felt it our duty to state the facts; and we leave our readers to make their own comments thereon. We have only to add, that we believe Mr. Wyld is not the man to shrink from meeting Mr. R. in a court of law, if he wishes it, and, as to the issue, we have no apprehensions.

*Edinburgh and Glasgow Railway.*—We understand that the promoters of this line have almost closed their proofs before the Committee of the House of Commons, very much in favour of the undertaking.

*Glasgow, Paisley, and Ayrshire Railway.*—The Parliamentary Committee on this Bill have agreed unanimously to report to the House that the preamble has been proved. The evidence has proved a clear return of upwards of 12 per cent. to the shareholders, on the cost of the undertaking.—*Caledonian Mercury.*

*Greenwich Railway.*—The actual number of passengers which have passed over this line from December 14 to May 24, we have ascertained to be 653,705, and the receipts 17,609*l.* 5*s.* 8*d.*, giving a daily average of 4,035 passengers, and 108*l.*

Passengers and Receipts on the Greenwich Railway.

	Passengers.	Receipts.
Whit-Sunday, 14th May - -	6,312 - - -	£190 13 0
	Footpath - - -	8 2 0
Whit-Monday, 15th — - -	23,267 - - -	651 8 6
	Footpath - - -	22 3 6
Whit-Tuesday, 16th — - -	24,601 - - -	629 5 0
	Footpath - - -	18 19 5
Wednesday, 17th — - -	13,080 - - -	332 10 0
	Footpath - - -	6 15 0
	<hr/> 67,270	<hr/> £1,859 16 5

*Great Western Railway.*—The greatest exertions are making by this Company, and both officers and men are labouring night and day. No doubt whatever seems to be entertained but that it will be opened to Maidenhead by October. We understand every part of the work is exceedingly well done, and if there is any fault it is in being too well done, if such a thing can be.

*Harwich, and Thames Haven Railways.*—The friends of these lines, we find, begin seriously to think of following the hint given in our last, and of bringing their lines right on to London. We hear the Harwich engineer has actually found a much less objectionable line than the Eastern Counties. Why, then, do not the two Companies unite in the construction of a common part to the capital? It might help the Eastern Counties out of the very awkward dilemma they are in with Lord Petre, and confer on them a great and incalculable benefit, which no doubt would be gratefully acknowledged.

*Kent Railway.*—Fate seems to have preserved one of her bitterest potions for this Company. It fell into Mr. Warburton's hands in the beginning of March. The Hon. Member made his report towards the end of April, and now, to the end of May, it has not been considered, and the evidence only just published. We suppose Mr. Warburton has not got his steam up, or is labouring on some steep incline, and wants an assistant engine to

push him forward. Whether the Company will be broken up or not, depends on the shareholders, who will be called together on the 8th instant. If it should, no doubt another party will soon take up the line; for it is not to be supposed that the large and populous places of Gravesend, Rochester, Chatham, Canterbury, &c., will long remain without a direct railway communication with each other and the capital. The present proprietors will then be in this situation,—they will have spent all, or nearly all their money for the benefit of other parties. For it will be remembered, the surveys and every thing else ready to go into Parliament, are complete; and that consequently there is no further expense but the insignificant one of the office to be incurred. We seriously recommend the shareholders well to weigh these circumstances before they determine on breaking up the Company, and cutting themselves off from all chance of ever being repaid what they have already advanced, and throw the fruit of all their labours into the pockets of others. If the Park or Dover are stumbling-blocks, strike them out; the line can be well made without the one, and will pay handsomely without the other.

On the 4th ult., an injunction was obtained against the funds and further proceedings of the Directors, which, in our opinion, was eminently absurd.

*Leipsic, April 24.*—The railroad from Leipsic to Althen (two leagues) was opened to-day in the presence of a great concourse of spectators. His Royal Highness Prince John was present, and took his seat in the first carriage. The journey was performed five times from Leipsic to Althen and back in the course of the day. The first time the distance of two leagues (five miles) was performed in 21 minutes.—*Times*.

*Liverpool and Manchester Railway.*—A severe attack has been made on this, and partly on the Birmingham Railway, and generally on all railways, by a writer in the "Times," of May 9. The gravamen of the charge is, that the line which was originally estimated at 510,000*l.*, is now to cost 1,624,375*l.*, and that the Company have borrowed more money than they have actually paid away to the shareholders. Now the fact is, that the 510,000*l.* was only intended to make the line, and did not comprise an immense portion of the undertaking, namely, the *carrying department*, including wharfs, warehouses, cranes, watering stations, repairing shops, engines, carriages, wagons, tunnels, sheds, yards, offices, &c., which have cost upwards of 400,000*l.*, besides the new coach station, in Lime-street, with the tunnel opened last August, about 150,000*l.* more. There have been therefore 550,000*l.* expended, over and above the estimate, for the purposes of the trade, extending the line, and accommodating the increased traffic of the railway. Though we are by no means defenders of the system of under-estimations, we have felt it our duty to lay before our readers the above particulars, to neutralize the prejudice the article in question is calculated to raise against railways generally. We have collected

some particulars respecting the earlier history of this father of railways, which we intended to lay before our readers in the present No., but must put off to another opportunity.

*London, Exeter, and Falmouth Railway.*—This Company have preferred abandoning their Bill for the present to going into Mr. Warburton's dissecting-room. The shareholders are to be called together, and they will have to exercise their judgment whether the work having been done and all the expenses incurred, it is better now to give up the undertaking, or receive a small dividend back.

*Manchester and Staffordshire Railway.*—We understand that the Committee to determine upon a line of railway, taken from the South Union and Cheshire Junction lines, have announced that they shall report in favour of the Cheshire Junction from Manchester to Harecastle, and in favour of the South Union from Harecastle southwards. The question of the new line is therefore settled, and the two Companies are now virtually one.—*North Derbyshire Chronicle.*

*North Midland Railway.*—The line of this railway will be carried on the eastern side of Chesterfield, over an embankment, and not on a series of arches. The embankment will cross the river Rother, near Hasland bridge, at a height of 23 feet, thence across the turnpike, between the bridge and the Horns public-house, and over the river Hipper, at an elevation of 19 feet. It will be carried across the meadows at a height of 20 feet, diminishing to fifteen feet on its approach to the road leading to Spittal bridge from Chesterfield. Arches, commensurate with the different heights of the embankments, will be constructed at those points where the line is carried over the roads, and the roads lowered.—*Derbyshire Courier.*

*Newcastle and Carlisle Railway.*—We have received, but too late for detailed notice in the present number, two interesting reports of this Company's proceedings. It appears from the reports that the works are proceeding rapidly towards a completion, and that the portions already completed are brought into growing and profitable use. In the four weeks of March the weekly receipts exhibited the gratifying spectacle of a rapid and regular rise from 600*l.* to 695*l.*, 720*l.*, and 874*l.* The direction of this concern we must confess appears to us to be composed of men of business and judgment not often met with in railway companies.

*Preston and Longridge Railway.*—We are happy to inform the public that this undertaking is in a fair way of being completed in a very short period. Mr. Wilkie, the contractor, has broken ground. It is expected that the railway will be in full operation by this time next year.—*Preston Chronicle.*

*Southampton Railway.*—This Company has applied to Parliament for powers to raise an additional capital of 400,000*l.* The Bill readily passed the Commons, but in the Lords was stayed, because there was not a deed for this 400,000*l.* duly subscribed,

according to the Standing Orders, though in the Act there is a specific clause rendering it unnecessary. The plan proposed is to create 16,000 new shares, of 25*l.* each, which are to be entitled to the same dividends as the original 50*l.* shares, which have been very eagerly taken by the proprietors of original shares. At a meeting of the shareholders lately held, Mr. Easthope, who was in the chair, made a most able statement of the situation and prospects of the Company, in all of which he was amply borne out by other parties and documentary evidence. It appears from the best evidence that the returns have been much understated, and that the works are very forward, and proceeding with great rapidity. All the works between London and Kingston will be finished by the end of August, and opened on May 1, 1838. It is expected to get within six miles of Guildford by the 24th of June, 1838; to Basingstoke by Lady-day, 1839; and to Southampton itself in the spring of 1840. We hear between 4,000 and 5,000 men are now employed on the line.

*South Union, and Manchester, Chester, and Staffordshire Rival Railways.*—Capt. Alderson, an officer of engineers, has examined the respective lines of the two contending companies, and reported on the subject to the Master-General of the Ordnance. Capt. Alderson objects to the line through Macclesfield, and prefers that part of the South Union line which lies between the Harecastle summit and the Grand Junction Railway. As a whole, he gives the preference to the Manchester, Cheshire, and Staffordshire line.  
—*Lancaster Guardian.*

*Sheffield and Rotherham Railway.*—The works on the Sheffield and Rotherham Railway are proceeding very satisfactorily, at Brightside, at Blackburn Forge, and at Jordan Dam. We have heard that 9764*l.* 1*s.* 10*d.*, the amount awarded for the Duke of Norfolk's land, is paid, so that we may expect operations to be shortly commenced nearer home. The North Midland Railway Company in order to carry into effect their arrangements with this Company are about to execute that part of their railway, which is between Rotherham and the Greasborough Coal-field, at which place we understand that Earl Fitzwilliam is lengthening his colliery railway, in order to join it; so that at no distant day the town may look forward to an abundant supply of that indispensable article, coal.—*Sheffield Iris.*

*Standing Orders on Railway Bills.*—The House of Lords has adopted the following additional Standing Orders on railway Bills:—

“Resolved—That before any Bill shall be read a second time in this House for making any railway, or for varying, extending, or enlarging any such railway already made, lists of the owners, lessees, and occupiers, distinguishing which of them have assented to, or dissented from, such intended railway, or such variation, extension, or enlargement, or are neuter in respect thereof, up to the time of such Bill having been brought up to the House from the

House of Commons, and an estimate of the expense, signed by the person making the same, and a copy of the subscription contract after-mentioned be deposited in the Office of the Clerk of the Parliaments, and that the receipt thereof be acknowledged accordingly by one of the clerks of the said office upon such documents.

“Resolved—That no Committee on any private Bill relating to railways shall have power to examine into the compliance with the Standing Orders, nor into any parts of the contents of any notice, list, application in writing, estimate, book of reference, or contract, nor of any plan or section, or copy of any plan or section, which are or may be hereafter ordered by any Standing Order of the House, to be given, made, deposited, or produced by the parties applying for such private Bill previously to the second reading thereof in the House, excepting only in so far as may be required to enable such Committee to report as to the sufficiency of the estimate to be proved in evidence before them according to the Standing Orders of the House.”

*Ulster Railway.*—Some reflections have been made on the Directors of the Ulster Railway Company, particularly in having made a second call from the shareholders at this particular juncture. We, however, hear that the work is progressing rapidly under the auspices of the present Board of Management. The entire expenses (including the Act of Parliament, surveys, plans, &c.) incurred to the present moment, fall short of 6,000*l.*, and already the works are in full operation, and reasonable hopes are entertained that within two years the line will be opened for traffic between Belfast, this town, and Lisburn.—*Belfast News Letter.*

*Warburton's Report on the Kent Railway.*—We have, only just before going to press, received a copy of the evidence on which the above very notable report is based. The evidence in several places is most incorrectly given, both as to questions and answers, as far, as ours is concerned; and we presume, it is not more fortunate in other cases. Neither is the report a correct representation of the evidence as printed. Before such evidence is sent forth to the world, it surely ought to be read over to the parties whom it is to affect, as in some cases it is in our courts of law. We regret the late period of our receiving the evidence compels us to postpone our observations on that and the report, which, it will be seen we are printing complete.

*Warburton and the Railways.*—Various schemes are contrived to repay the Hon. Member for the discredit and expense he has occasioned to many parties. Report (not Mr. Warburton's) says the Hon. Member does not like the ladies, which is so very wicked a calumny—so unlike an Englishman—we cannot believe it. However, some of the companies have resolved to make all their directors and officers of ladies, whose pretty faces, it is said, will drive the Hon. Member, not only out of the room, but out of Parliament too. We, however, have resolved on a different plan; we will no more patronize Warburton's omnibuses. This loss may amount to 1*s.* 6*d.* per week, or 3*l.* 18*s.* per year, enough to buy



the Hon. Member a decent modern hat, a new pair of "tights," to paint his door, put another chair in his room, pay a charwoman once a month to wash it, and leave about 5s. 6d. for pocket-money, and to buy a few savoury herbs with.

*Belgium Railroads.*—M. Nothomb, the Minister of Public Works in Belgium, has just published a report respecting railroads in that country, from which it appears that the roads adopted by the Government to form the system of communication, have for their central point Malines, and their direction is east towards Prussia, by Louvain, Liege, and Verrier; to the west by Ostend, Termonde, Gand, and Bruges; to the south by Brussels, and from Brussels towards the frontier of France by the Hainout. This forms an extent of 115 leagues. The works were commenced soon after the promulgation of the law of the 1st of March, 1834, and three sections have been opened to the public. This extent is more than 14 leagues. These sections are from Malines to Brussels, from Malines to Antwerp, and from Malines to Termonde. The total cost of these three sections was 5,181,633f., and deducting 200,000f., for property purchased, but which may be hereafter sold, their cost may be estimated at 357,000f. per league. To these expenses must be added, the expense of the transport of materials, and the establishment of stations, amounting to 1,848,355f. During the year, from May 1835 to May 1836, the section from Malines to Brussels produced 359,394f. 15c., or an average of 29,949f. 51c., per month. The number of passengers was 563,210, or an average of 46,934 passengers per month. During the eight months from May to December, 1836, the two branches from Malines to Brussels, and from Malines to Antwerp, produced 734,736f. 20c., or 91,842f., per month. The number of passengers was 729,545, or 91,193 per month. The amount taken during the present year, presents about the same average, but M. Nothomb calculates that there will be about the same number of passengers on each of the three lines, so that the number of passengers annually by each line will be 500,000. The annual expenses of each line are calculated at 745,000f., and the whole expenses, including repairs, interest, and sinking fund, at 1,069,000f. Six millions of capital were raised in the first instance. In order that there shall be no loss, the receipts of the three sections must, therefore, amount to 1,069,000f. The rates of conveyance on the Belgian railroads are much lower than on any of the others. There are places at only ten centimes (about a penny) the league. On the Liverpool Railroad the lowest price is fifty-five centimes. On the railroad from Paris to St. Germain the maximum price is forty centimes. Six new lines are in the course of construction—from Louvain to Tirlemont, Tirlemont to Waremmé, Malines to Louvain, Termonde to Gand, Waremmé to Ans, and Gand to Bruges. The sum of 6,603,250f. has already been expended on these lines. In addition to these railroads constructed by the State, thirty-seven are contemplated by private individuals or companies. The most considerable is that between

Sambre and Meuse, which, with its branches, will be 25 leagues in extent.

*Genoa and Piedmontese Railway.*—The "Genoa Gazette" of the 25th, publishes a Royal decree, creating a special commission to examine the several plans presented to the Government, for an iron railroad between Genoa and the Piedmontese provinces. The commission is to point out that plan, the execution of which would be the most eligible.

*Prussian Railroads.*—A plan has just been published at Cologne, of the line of the iron railroad, as fixed by the Prussian Government. From Cologne it goes to Mungersdorff, crosses the high road from Juliers, and passes between Weeden and Uesdorff, taking by Koenigsdorff and Mary, in a direct line, the direction of Bider, where it descends to Duren, and ascends beyond that town to Eschweiler, passing through Grich, Langerwehl, and Weisweiler. Here the line becomes irregular, the road goes in curves by way of Roche, Vertanturheid, between Borcelle and Aix-la-Chapelle, through Beldschen, Erinburgh, and Rusch, to Herbestal, where it is to join the Belgian railroad. Between Aix-la-Chapelle and Erinburgh, there is to be a tunnel 500 rods in length; a second near Vertanterheid, and a third near Koenigsdorff; the two last are to be each 150 rods in length.—*Mining Journal.*

*Paris and St. Germain.*—Vast numbers of persons flock to view the progress of the railroad constructing from Paris to St. Germain. The works are in a very advanced state, and it is asserted, but which we doubt, will be quite ready to come into operation in July.—*Liverpool Standard.*

*Railroads in France.*—The construction of railroads is being carried on in France with great spirit. Some of the lines are undertaken by the Government, and others by private companies, as in this country. The most important lines which have been determined upon, are the following:—From Paris to Havre, passing through Rouen, a distance of 55 leagues; from Paris to Calais 53 leagues; from Paris to Lisle 53½ leagues; from Paris to Lyons and Marseilles 219 leagues; from Paris to Strasburg 116½ leagues; and from Paris to Bordeaux 154 leagues. Besides these principal lines, of which the central point is Paris, there are numerous branches of considerable importance to the commerce of the country.

*Russian Railroad.*—The thaw has so far advanced, that the works on the line of railway are to be recommenced at the Umfangs Canal, within the town, in the ensuing week. The whole of the earthwork must, by contract, be completed by the 15th of June. The solidity of the embankment has been established, by its not having sustained the least injury during the winter. The disbursements since the 1st of January, amount to 289,386 rubles 6 copeks. The Company have disposed of all their shares. The 2,500 reserved shares were placed principally abroad.—(From the "St. Petersburg Zeitung," 6th of May.)

## PARLIAMENTARY PROCEEDINGS.

### HOUSE OF COMMONS.

Of the 77 railway Bills brought into Parliament this session, 24 have already been thrown out or withdrawn. In our next number we will give a correct list of these Bills, together with any others that may, in the mean time, be lost or withdrawn.

Ardrossan and Johnston, reported May 5. Birmingham and Derby (No. 2), reported May 11; 3d, May 25. Bishop Auckland and Weardale, 1st, May 1; 2d, May 9.

Cheltenham, Oxford, and (Charlton Kings), reported May 2. Chester and Birkenhead, reported May 8; 3d, May 18. Clarence and Hartlepool (Great North of England), reported May 11. Cork and Passage, reported May 1; 3d, May 10.

Dublin and Drogheda, reported May 3. Dundalk Western, reported May 23.

Exeter and Falmouth, reported May 1.

Glasgow, Paisley, and Greenock, reported May 17; 3d, May 27. Glasgow, Paisley, and Ayr, reported May 8.

Kilmarnock and Troon, reported May 4; 3d, May 25.

Leicester and Swannington, 3d, May 5.

Manchester South Union, reported May 22.

Slamannan, 3d, May 3.

Wishaw and Coltness, reported May 1.

*April 28.*—Mr. Stewart complained of the conduct of the Committee which had rejected Stephenson's line, and made a motion to have it referred back, which was eventually withdrawn. Mr. Young presented a petition from Daniel Edward Stevens, against certain subscriptions to Rennie's deed. Referred to Warburton's Committee.

*May 1.*—Bath and Weymouth Bill, lost on second reading, by a majority of 22.

*May 9.*—Sir C. Burrell moved that the Committee on the Brighton lines be ordered to make a separate report on each line, to enable the House to determine on which should be sent back for having the landowners heard thereon. After a lengthened discussion, it was carried by 77 to 72.

Lord Ebrington, the Chairman of the Committee, moved that the report of the Exeter and Falmouth Bill be read that day six months. It was carried, and the Bill, of course, is lost.

On the motion of Mr. Barneby, the same fate fell on the Grand Connexion, (Worcester and Wolverhampton) Bill.

*May 10.*—On the motion of Mr. B. Wilbraham, ordered that the Committee on the Manchester and Tamworth, and Manchester and Stafford lines, have power to authorize the consolidation of the two.

*May 11.*—A long discussion, ending in nothing, about members being allowed to vote on railway Bills who were shareholders in them.

*May 22.*—Sir A. Agnew presented a petition from the General Assembly of Scotland, praying for a clause in all railroad Bills to prevent travelling on them on a Sunday!!!

*May 23.*—Mr. Stewart presented a similar petition from Greenock, and Sir A. Agnew another from the General Assembly of the Church of Scotland. A long discussion followed, in which Sir R. Peel made some very just observations on the absurdity of legislating on the subject; and it was understood Sir A. Agnew was to bring in a specific Bill for the purpose. We hope the House will not be so absurd as to sanction it. A man without religion is, in our opinion, a body without a soul; but to carry religion to so ridiculous a length as to stop the motion of inanimate matter in cases, perhaps, of the greatest emergency, savours more of fanaticism than pure religion. Does the Almighty stop the course of the heavenly bodies, or of the seasons? Has he forbid the sun to shine, the clouds to rain, or vegetation to progress on a Sunday? Why, then, if the works of the Deity himself go on, are those of man to be arrested?

*May 25.*—Mr. Curteis presented a petition from Mr. Mills, engineer of one of the Brighton lines, on those lines, which was ordered to be printed.

*May 26.*—Lord A. Lennox, from the Provisional Committee, on Stephenson's Brighton line; and Alderman Wood, from the secretary of Gibbs's, praying their lines may be referred back to the Committee.

Sir G. Sinclair presented another Scotch petition against Sunday travelling.

#### HOUSE OF LORDS.

*May 12.*—The Earl of Shaftesbury carried some alterations in the Standing Orders, for which, see Standing Orders in our Railway Notices.

Eight Bills have received the Royal Assent since our last, namely, Birmingham and Gloucester Amendments—Liverpool and Manchester—Lancaster and Preston—Manchester and Leeds—North Midland—Preston and Wyre, Amendments—Sheffield and Ashton—Whitby and Pickering, all May 5th.

The other stages are:—Birmingham and Derby Junction, 1st, May 25th. Chester and Crewe, 1st, April 28th; 2d, May 18th. Chester and Birkenhead, 1st, May 18th. Cork and Passage, 1st, May 10th; 2d, May 23d. Durham and Sunderland, 1st, April 28th; 2d, May 8th. Glasgow, Paisley, and Greenock, 1st, May 26th. Glasgow, Paisley, Kilmarnock, and Ayre, 1st, May 22d. Great North of England, 1st, May 11th. Kilmarnock and Troon, 1st, May 26th. Leicester and Swannington, 1st, May 5th; 2d, May 18th; 3d, May 25th. London and Birmingham, 2d, May 3d. London and Greenwich, 2d, May 2d; 3d, May 26th. Maryport and Carlisle, 1st, May 9th; 2d, May 19th. Slamanan, 1st, May 5th; 2d, May 23d. Taff Vale, rep. May 8th. York and North Midland, 1st, May 5th; 2d, May 18th.

# PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on										
					April.		May.								
					28.	2.	5.	9.	12.	16.	19.	23.	26.		
			£.	£.	2	3½	5	4½	.....	3½	3½	3½	3½		
9,500	.....	(3) Birmingham and Derby .....	.....	10	2	3½	5	4½	.....	3½	3½	3½	3½		
7,500	.....	(3) Birmingham and Gloucester .....	.....	10	1½	2	3½	2	1½	.....	.....	.....	.....		
		(2) Birmingham, Bristol, and Thames Junction .....	20	3	.....	.....	.....	.....	.....	.....	.....	.....	.....		
15,000	.....	(2) Bristol and Exeter .....	100	10	.....	.....	.....	.....	3	2½	.....	.....	.....		
660	.....	Calcutta and Saugur .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....		
350	.....	Cheltenham .....	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
7,500	.....	(3) Cheltenham and Great Western .....	100	7½	.....	.....	.....	.....	.....	.....	.....	.....	.....		
14,000	.....	(4) Cheltenham, Oxford, and Tring .....	100	5	.....	.....	.....	.....	.....	.....	.....	.....	.....		
2,000	.....	(2) Clarence .....	100	100	40	.....	.....	42	.....	.....	.....	40	.....		
12,000	.....	(3) Commercial Blackwall .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....		
8,000	.....	(4) Dublin and Kilkenny .....	100	2½	.....	.....	.....	.....	.....	.....	.....	.....	.....		
7,500	.....	(4) Durham South-West Junction .....	20	3	.....	.....	.....	.....	.....	.....	.....	.....	.....		
60,000	.....	(3) Durham Junction .....	100	10	.....	.....	.....	.....	.....	.....	.....	.....	.....		
64,000	.....	(2) Eastern Counties .....	25	2	.....	.....	.....	.....	.....	.....	.....	.....	.....		
5,000	.....	Edinburgh and Dunbar .....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....		
13,000	.....	(3) Edinburgh, Leith, and Newhaven .....	20	3	.....	.....	.....	.....	.....	.....	.....	.....	.....		
800	.....	(4) Edinburgh and Glasgow .....	50	2	.....	.....	.....	.....	.....	.....	.....	.....	.....		

2,800	.....	(4) Glasgow and Falkirk Junction ...	50	3	40½	42½	41½	40	40½	41	41	42½	41½
25,000	.....	(2) Grand Junction .....	100	50									
2,000	.....	(3) Great North of England .....	100	7									
11,000	.....	(2) Great Western .....	100	40	40½	42½	41½	40	40½	41	41	42½	41½
8,000	.....	(2) Hartlepool .....	100	100									
40,000	.....	(4) Harwich .....	20	1									
40,000	.....	(2) Hull and Selby .....	50	5									
2,000	.....	(4) Kent .....	50	2									
2,100	.....	(4) Llanelli Railway and Docks .....	100	25									
1,500	.....	(1) Leeds and Selby .....	100	100									
5,100	.....	(1) Leicester and Swanton .....	50	50									
	oz. per c.	(1) Liverpool and Manchester .....	100	100									
10,000	.....	Ditto, ¼ shares .....	25	25									
45,000	.....	(4) London and Brighton (Stephenson's)	100	5	2½	1½	1½	1½	2	3	1½	1½	1½
16,000	.....	— (Gibbs) .....	20	1	1½	1½	1½	1½	1½	1	1	1	1½
8,000	.....	(4) — (Rennie) .....	50	3	1½	1½	1½	1½	1½	1	1	1	1½
12,000	.....	(4) — (Cundy) .....	100	3	1½	1½	1½	1½	1½	1	1	1	1½
20,000	.....	London and Blackwall .....	50	3	19	18½	19	19½	19	18	16½	17	16½
	3l. per c.	(2) London and Greenwich (ex div.) ..	20	20	98	98	98	98	98	16½	17	16½	16½
25,000	.....	Ditto, Bonds .....	100	85	111	116	119	116	116	117	120½	128	126
20,000	.....	(2) London and Birmingham .....	50	40	98	98	98	98	98	17	17	17	17½
16,000	.....	Ditto, Bonds, 1834 .....	25	1	13	12½	15	14	12½	11½	11½	11½	11½
12,000	.....	(2) London and Southampton .....	50	3	11½	11½	13	13	12	12	12	12	12
10,000	.....	(3) Ditto, Ditto, New .....	100	5	5	7	7½	6½	6½	6	6½	6½	6
10,000	.....	(3) London and Croydon .....	100	5	3½	4	5	4	3½	4½	4½	4½	4
10,000	.....	(3) Manchester and Leeds .....	100	5	3½	4	5	4	3½	4½	4½	4½	4
10,000	.....	(4) Manchester and Birmingham .....	100	5	3½	4	5	4	3½	4½	4½	4½	4
10,000	.....	(4) Manchester South Union .....	100	5	3½	4	5	4	3½	4½	4½	4½	4

# PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on									
					April.		May.							
					28.	29.	3.	5.	9.	12.	16.	19.	23.	26.
15,000	.....	(3) Midland Counties .....	50	5										
12,000	.....	(3) North Midland .....	100	15	11	14	14	14	13	13	12 $\frac{3}{4}$	12 $\frac{3}{4}$	12 $\frac{3}{4}$	12 $\frac{3}{4}$
2,500	.....	(3) Northern and Eastern .....	100	6										
2,600	.....	(2) Preston and Wigan .....	.....	20										
2,600	.....	(2) Preston and Wyre .....	50	28										
4,000	.....	(3) Sheffield and Rotherham .....	25	6										
1,000	6d. per c.	(1) Stockton and Darlington .....	100	100	3									
1,500	.....	(2) Stanhope and Tyne .....	100	100										
3,000	.....	(4) South Durham .....	50	2 $\frac{1}{2}$										
28,000	.....	(2) South-Eastern and Dover .....	.....	7	1	.....	3 $\frac{1}{4}$	3 $\frac{1}{4}$	3 $\frac{1}{4}$	3	2 $\frac{1}{2}$	2 $\frac{1}{2}$	.....	2 $\frac{1}{2}$
24,000	.....	(4) Do. Brighton, Lewes, and Newhaven .....	50	2	.....	1	1 $\frac{1}{2}$	1 $\frac{1}{2}$	.....	.....	.....	.....	.....	.....
40,000	.....	(4) South Midland .....	50	1										
9,000	.....	(3) South-Western (Stephenson's) ...	50	1										
6,600	.....	(4) Thames Haven .....	50	2 $\frac{1}{2}$										
1,400	.....	(4) Victoria .....	25	1										
	.....	(4) Westminster and Greenwich .....	50	2										
6,000	.....	(3) York and North Midland .....	50	3										

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of  $\frac{1}{4}$  in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

## ADDITIONAL ERRATA IN VOL. I.

- Page 402, line 8 from bottom, for *suis*. read *suiv*.  
 — 403, line 15 from bottom, for *level* read *bevel*.  
 — 415, et *suiv*, in the article on the "GREAT WESTERN RAILWAY," for *Levindon* read every where *Swindon*.  
 — 417, line 14, for *road* read *end*.  
 — 418, line 19, dele *not*.  
 In the same page, for *Stevenson* read *Stephenson*.  
 Ditto, in note, line 13 from bottom, put full stop after *effect*.  
 Page 420, line 16, read semicolon before, and dele comma after *guage*.  
 — 420, line 6 from bottom, dele *Cost*, and read it in next line, before *For*.  
 — 421, line 2, for 522,184 read 525,688.  
 In the same page, line 6, for 265,823*l*. 14*s*. 7*d*. read 265,823*l*. 4*s*. 7*d*.  
 Ditto, last column but one of table, for *Miles* read *Fect*.  
 Page 435, line 19, for *is* read *are*.  
 — 444, line 7, for *B* read *C*.  
 — 450, line 12, for *Bailey* read *Baily*.  
 — 10 from bottom, for *Renni* read *Rennig*.  
 — 460, line 14, for *Kempeler's* read *Kempelen's*.  
 — 463, line 2, for *congestion* read *congestions*.  
 — 16, for *induced* read *adduced*.  
 — 18, after *into* insert *the*.  
 — 28, for *flux* read *influx*.

## IN THE INDEX.

- For *Bravenden's* read *Bravender's*.  
 For 38, after Notices, Railway, read 35.  
 For *Railway Pneumatics* read *Railway, Pneumatic*.  
 For *Ellectro* read *Electro*.

## IN THE INDEX TO NOTICES.

- For *Tolds* read *Tolls*.

## ERRATA IN VOL. II.

- Page 64, line 21 from bottom, for *cobia* read *cobra*.  
 — 70, line 8, for *dinner* read *déjeuner*.  
 — 101, upper line in last column, for 3,663,500 read 3,863,500.  
 — 176, line 19, for *Annnaire* read *Annuaire*.  
 — 274, in fifth paragraph, for *Vienna* read everywhere *Venice*.  
 — 277, in line with March 22, for *motion* read *notion*.  
 — 303, in 10th line of second article, for *That is the differential* read *That is, the  $t$  differential*.  
 — 340, line 12, after *was* insert *negatived*.



# INDEX TO COMMUNICATIONS, &c.,

## VOL. II. NEW SERIES.

- Axletree Friction, 24  
 Aerostation, on Utility of, 51  
 Advantage of employing Steam of great density expansively in Locomotives, 162, 214  
 Anti-Humbag, on the Cheltenham, Oxford, and London Railway, 224  
 Avery's Rotary Engine, 300  
 Assistant Engines, Rule for computing the Velocity with, 150  
 ————— to find the weight of, 148  
 Atmosphere, calculation of its effects on a Train, 345  
 Bills, Railway Notices for 1837, 8  
 Birmingham Railway, Sir John Rennie's Report on, 26  
 Brighton Railways, 97  
 Booth, Henry, Esq., Treas. Liv. and Man. Railway, Improvements in Tunnels, 102  
 Branch Lines of Railway, 85  
 Cheltenham, Oxford, and Tring Railway, 40, 114, 116, 224  
 "C." rejoinder to Mr. Maugham, 45  
 Chimneys, New Plan of Bricks for, 60  
 Continuous Bearings, Mr. Vignoles's, 73  
 Commercial laying out of Railways, 81  
 Canals and Railroads in the United States, 100  
 Conspectus of Traffic on Liverpool and Manchester Line for six years, 220  
 Cordier, M., on the Fuel of Steam-engines, 281  
 Calculation on High Pressure Steam-engines, 290  
 Correspondence that led to Sir H. Davy's exit from the Chair of the Royal Society, 309  
 Canal Lock, improved one, 366  
 Diseases, Influence of Artificial Rarefaction and Condensation on, 94  
 Duplicate Tunnels, 219  
 Demonstrations of Dr. Pell's Theorems, by "J. J.," 302  
 Davy, Sir Humphry, Correspondence that led to his exit from the Presidency of the Royal Society, 309, 389  
 Earth Work, Time, &c., of, 154  
 Economy of High Pressure Steam-engines, a Question relative to, 307  
 Editor, on Throttling of Steam in Locomotives, 1  
 —, Utility of Aerostation, 51  
 Editor, Commercial Laying out of Lines of Railway, 81  
 —, Experiment on Light, 117  
 —, What will Parliament do with the Railways? 118  
 —, on Principles of Locomotion, Assistant-engines, &c., 145  
 —, on the Kent Railway and Parliamentary Inquiry, 167  
 —, Avery's Rotary Engine, 300  
 —, a Theorem in General Differentiation and Integration, 303  
 —, Calculation of Effects of Atmosphere on a Train, 345  
 —, Suggestions on Standing Orders, 370  
 Estimate of present and Mr. Vignoles's Method, of Constructing the Upper Works of Railways, 110  
 Foreign Railways, 74  
 Fuel of Steam-engines, 281  
 Field, Joshua, Esq., F.R.S., &c, Improved Canal Lock, 366  
 Gompertz, Lewis, Esq., new Plan of Bricks for Chimneys, 60  
 Harwich Railway, 34  
 Heated Metals, Experiments on, 160  
 High Pressure Steam-engines, Calculation on, 290  
 —————, a Question on the Economy of, 307  
 Herapath, Mr., and Royal Society, 309, 389  
 Hull and Selby Railway, 355  
 Iron and Steel, Habitudes of, 45  
 Insurance Companies, 95  
 Interference of Light, Experiment on, 117  
 Insurances, Life, 365  
 Kreeft, Christopher, Esq., on the Russian Railroad, 52  
 Kent Railway, and the Parliamentary Inquiry, 167  
 Locke, Joseph, Esq., Report on Sheffield and Manchester Railway, 20  
 London, Rochester, and Chatham Railway Absurdity, 54  
 Lecture on Railways, 55, 90  
 Lines of Railway, Commercial Laying out of, 81  
 Letter, Extract from, to the Editor, 112  
 Light, Experiment on, 117  
 Locomotion, some Principles of, 145  
 Locomotives, Resistance of, 200  
 Liverpool and Manchester Railway, Traffic for six years, 220

- Letter to the Editor, Extract from, 308  
 Light for a Diving Bell, 354  
 Life Insurances, 365  
 Mechanicus on Axle-tree friction, 24  
 Miscellaneous and Scientific Intelligence,  
     61, 122, 168, 263, 321, 394  
 Moore, John, Esq., on Steam Navigation,  
     105  
 Madras Military Fund, Mismanagement  
     of, 155  
 Maryport and Carlisle Railway, 286  
 Midland Counties Railway, 303  
 Maugham, Wm., Esq., Light for a  
     Diving-bell, 354  
 Notices for Railway Bills for 1837, 8  
     — Railways, 73, 133, 199, 271,  
         329, 405  
 "Nauticus," a Question relative to High-  
     pressure Engines, 307  
 Omicron on the Mismanagement of the  
     Madras Military Fund, 155  
 Obituary of Mr. James, Projector of the  
     Liverpool and Manchester Railway,  
     341  
 Progress of Railway Works, 69, 132,  
     178  
 Prices of Shares, 78, 142, 206, 278, 342,  
     416  
 Practical Rule for Computing Throttling  
     of Steam, 5  
 "Philo Taffy" on the London, Rochester,  
     and Chatham Railway, 54  
 Parliament, what will they do with the  
     Railways? 118  
 Principles of Locomotion, 145  
 Pambour's, M., Rule for calculating  
     Friction, 161  
 Parliamentary Proceedings, 204, 276,  
     339  
 Practical Rule for Calculating the Ve-  
     locity with Assistant Engines, 150  
 Pambour, M., on Resistance of Loco-  
     motives, 200  
     — Calculation of High-  
         pressure Engines, 290  
 Pell's, Dr., Theorems, Demonstrations  
     of, 302  
 Proceedings in Parliament on Private  
     Bills, 204, 276, 339, 414  
 Report, Mr. Vignoles', on the Upper  
     Works of Railways, 107  
 Reports, Engineers', on Sheffield and  
     Manchester Railway, 12  
 Rennie, Sir John, Report on Birming-  
     ham Line, 26  
 Russian Railroad, 52  
 Robertson, Joseph Clinton, the London,  
     Rochester, and Chatham Absurdity, 54  
     (See also the various Notices of the  
     Eastern Counties Railway, and the  
     Wrappers.)  
 Railways, Lecture on, '55, 90  
 Review of Books, 68, 123, 175, 269,  
     400  
 Railway Notices, 73, 133, 199, 271,  
     329, 405  
 Rule, Practical, for computing Throt-  
     tling of Steam, 5  
 Rule, Practical, for computing the Ve-  
     locity with Assistant Engines, 150  
 Resistance of Locomotives, 200  
 Rowley, Mr., on Duplicate Tunnels, 219  
 Railway Reports, 178, 225, 313, 376  
 Royal Society and Mr. Herapath, 309,  
     389  
 Steam, Throttling of, in Locomotives, 1  
     — Navigation, Suggestions on, 105  
     — of great density used expansively  
         in Locomotives, advantages of, 162,  
         214  
     — Engines, Fuel of, 281  
 Sheffield and Manchester Railway, En-  
     gineers' Report thereon, 12  
 Scientific, &c., Intelligence, 61, 122,  
     168, 263, 321, 394  
 Shares, Prices of, 78, 142, 206, 278,  
     342, 416  
 Steel and Iron, Habitudes of, 45  
 Standing Orders, Suggestions on, 370  
 Tunnels, on Ventilating and Lighting,  
     86  
     —, Improvements in, 102  
     —, Duplicate, 219  
 Throttling of Steam in Locomotives, 1  
 Thompson, John, Esq., on Railway  
     Bills for 1837, 8  
 Tait, Wm., Esq., C.E., on Brighton  
     Railways, 97  
 Table of Length and Cost of Canals and  
     Railroads in the United States, 101  
 Tring Railway, 40, 114, 116, 224  
 Table of number of Working Days for  
     every month in the year, 154  
 Tait, Wm., Esq., C.E., on the time  
     occupied in the Execution of Earth-  
     work, 152  
 Traffic on Liverpool and Manchester  
     Railway for 6 years, 220  
 Theorem in General Differentiation and  
     Integration, 303  
 Vignoles, Charles, Esq., C.E., F.R.A.S.,  
     &c., Report on Sheffield and Man-  
     chester Railway, 12  
     — Report on Continuous bear-  
         ings and Upper Works of Railways,  
         73, 107  
     — Table of the Working Days  
         for every month in the year, 154  
 Works, Railway, Progress of, 69, 132  
     —, Upper, of Railways, 73, 107  
 Walker, James, Esq., C.E., &c., on  
     Ventilating and Lighting Tunnels, 86

## INDEX TO RAILWAY REPORTS.

- |   |  |
|---|--|
| <p>Birmingham, 190<br/>         Brunel, J. K., Esq., to Great Western Company, 187<br/>         Bristol, Birmingham, and Thames Junction, 225<br/>         Bristol and Exeter, 229<br/>         Birmingham and Gloucester, 243<br/>         Cheltenham and Great Western Union, 376<br/>         First Report on the Deptford and Dover Subscription List, 380<br/>         First Report of the Irish Commission, 246<br/>         Great Western, 182</p> | <p>Great North of England, 241<br/>         Liverpool and Manchester, 178<br/>         London and Southampton, 236<br/>         London and Croydon, 313<br/>         Lock, Joseph, Esq., to Sheffield and Manchester Company, 20<br/>         Medical Reports on Tunnels, 257<br/>         North Midland, 239<br/>         Thames Haven, 319<br/>         Vignoles, Charles, Esq. to Midland Counties Company, 107<br/>         ——— to Sheffield and Manchester Company, 12<br/>         York and North Midland, 234</p> |
|---|--|

---

INDEX TO SCIENTIFIC AND MISCELLANEOUS  
NOTICES.

- |   |   |
|---|---|
| <p>Application of Electro-Magnetism to manufacturing Purposes, 126<br/>         Acoustic Pyrometer, 170<br/>         Algebraic Equations, Solution of, 171<br/>         Agricultural Meteorology, 171<br/>         Astronomical Refraction, 171<br/>         American Value of English Physicians, 171<br/>         Animal Chemistry, 172<br/>         Avery's Steam-engine, 265, 300<br/>         American Locomotive, 326<br/>         Apples to feed Stock, 394<br/>         Boilers, Mercurial, 127<br/>         ——— Incrustation of, 397<br/>         Barometer, Influence of, on the mean Level of the Sea, 171<br/>         Balloon, great Vauxhall, 395<br/>         Chimneys, Mr. Gompertz's Plan for, 122<br/>         Canal-boat Experiments, 122<br/>         Construction of Public Buildings in reference to Sound, 124<br/>         Copying Writing, 126<br/>         Climate of Montreal, 170<br/>         Continuous Bearings, 170, 264<br/>         Clouds, Height and Depth of, 170<br/>         Chemistry of the Digestive Organs, 172<br/>         Coffee, Improvement of, 322</p> | <p>Carbonic Acid Gas, very low Temperature in Solidification of, 327<br/>         Cultivation on Climate, 396<br/>         Coldness of the Season, 397<br/>         Clouds, Figure of, above the Earth, 395<br/>         Copying Machine, 396<br/>         Drainage, Improvement in, 127<br/>         Durability of Wood, 324<br/>         Extracts from Log-book, 63<br/>         Electro-Magnetism, 323<br/>         Effects of Cultivation on Climate, 396<br/>         ——— Wood Land on Rain, 396<br/>         Fright, a little one, 64<br/>         Falling Stars, 64, 125<br/>         Fossil Remains, Gigantic, 397<br/>         Grass Oil, 62<br/>         Gordon's, Alex., Esq., C.E., Steam Carriage, 264<br/>         George Washington, Locomotive, 326<br/>         Galvanic Telegraphs, 327<br/>         Gas to Inflate Vauxhall Balloon, 395<br/>         Gas from Resin, 397<br/>         Height and Depth of Clouds, 170<br/>         Improvement of Coffee, 322<br/>         Limpkins's Experiment on Light, 61<br/>         Little Fright, 64<br/>         Light, 125<br/>         Lateral Draught of Running Water, 322</p> |
|---|---|

- Lunar Eclipse, 326  
 Light under Water, 326  
 Mountain, Magnetic, 61  
 M'Neil, John, Esq., Canal-boat Experiments, 122  
 Mineral Tallow, 127  
 Medallie Engravings, 168  
 Magnetic Intensity in the Higher Regions, 170  
 Mummy, supposed to be the body of Memnon, 263  
 Microscope, 264, Lamp, do., 265  
 Modern Mummy, 322  
 Mummy Cloth, 323  
 Maps, National, 325  
 Magnetic Apparatus, New, 397  
 Mortality of Paris, 395  
 National Maps, 325  
 New Lamp, 326  
 Oils, Grass and Tea, 62  
 —, Candle-tree, 172  
 Preservation of Fruit, 122  
 Planton's Railroad Car, 127  
 Paris, Mortality of, 395  
 Preservation of Bodies, 395  
 Reid, Dr., on the Construction of Public Buildings, 124  
 Rain, effects of Woodland on, 396  
 Ready Copyist, 396  
 Stars, Falling, 64, 125  
 Silver, Solidification of, in Fusion, 65  
 Snow on Railways, 122  
 Steam-power to Tillage, 172  
 Steam-carriages, 264  
 Slipping down of part of a Mountain, 264  
 Stone Meal used in China for Food, 265  
 Substitute for Steam-Power, 323  
 Steam-Vessels, 395  
 Steam in the Cylinder and Boiler, 397  
 Subsidence of a large portion of Earth, 397  
 Tea Oil, 62  
 Tallow, Mineral, 127  
 Tendency of Vegetables to approach or fly the Light, 326  
 Temperature extremely low, 327  
 Telegraphic Communications by Galvanism, 327  
 Van Mons' Method of Raising Fruit-trees, 173, 266, 327  
 Velocity of a River, 321  
 Upas Valley, 323  
 Vegetables, their tendency to approach or fly the Light, 326  
 Vesuvius, an emerged Volcano, 327  
 Writing, Copying, 126  
 Water, Maximum Density of, 170  
 Wind Wheel for Propelling Vessels, 171  
 White Natives in Africa, 265  
 Zinc for Covering Buildings, 397

## INDEX TO RAILWAY NOTICES.

- American, 76, 336  
 Anti-Dry Rot, 329  
 Belgium Railroads, 412  
 Birmingham, 132, 190, 199, 271, 274, 329, 405  
 Birmingham and Gloucester, 69, 243  
 Bristol and Exeter, 69, 133, 229  
 Brighton Lines, 73, 133, 199, 271, 329, 405  
 Bristol, Birmingham, and Thames Junction, 198, 225, 271, 329  
 Bolton and Preston, 133, 405  
 Calcutta and Saugur, 133  
 Commercial and Blackwall, 134  
 Central Kentish, 75, 329  
 Clarence Railway, 330  
 Cork and Passage, 330  
 Coal in India, 200  
 Continental Railways, 338, 412  
 Croydon, 137, 272, 312  
 Currie's, Mr., Plan for Railways, 132  
 Cuba, Railroads in, 141  
 Doncaster, North Midland, and Goole, 200, 272  
 Dublin and Kingstown, 405  
 Ease of Draught on Railways, 74  
 Eastern Counties, 74, 134, 200, 272, 330, 405  
 Edinburgh and Glasgow, 406  
 England and Ireland Communication, 272  
 Expedition of American Engineers, 337  
 Fleetwood Town and Port, 331  
 Gloucester and Bristol, 135  
 Great North of England, 201, 241, 332  
 Great Western, 74, 135, 182, 202, 332, 407  
 Gosport and Fareham, 75  
 Greenwich, 70; Additional Post by, 133; 135, 201, 273, 407  
 Grand Junction, 70, 132, 273, 331  
 Glasgow, Paisley, and Ayrshire, 406  
 Hampshire and Wiltshire, 75

- Harwich Railway, 332  
 Irish Commission, 202; 1st Report, 246  
 Kent, 332, 407  
 — Report, 332  
 Kent and South-eastern, 135  
 Leghorn and Florence, 77  
 Leeds and Manchester, 332  
 Limerick and Waterford, 135, 202  
 Liverpool and Manchester, 136, 178, 408  
 London, Salisbury, and Falmouth, 139, 202, 408  
 Locomotives, 136  
 Locomotive Power, 332  
 Leipsic and Althen Railroad, 408  
 Manchester, Cheshire, and Staffordshire, 75, 409  
 Manchester Connexion, 75  
 Manchester South Union, 274  
 Maunch Chink Coal-mine, 333  
 Midland Counties, 71  
 Newcastle and Morpeth, 202  
 Newcastle, Edinburgh, and Glasgow, 137, 202  
 Newcastle and North Shields, 72, 132, 202  
 Newcastle and Carlisle, 274, 334, 409  
 New Anti-Mephitic Apparatus, 136  
 New Railway, 132  
 New Description of Railroad, 334  
 North Midland, 239, 409  
 Northern and Eastern, 203  
 Paris and St. Germain, 413  
 Paris and Brussels, 274  
 Patriotism, 76  
 Petitioning Club, 271, 335  
 Plans and Sections Deposited, 138  
 Preston and Wyre, 137  
 Preston and Longridge, 409  
 Prussian Railroads, 413  
 Railroads in France, 413  
 Railroad across Isthmus of Panama, 77  
 Railroads in the United States, 337  
 Railway Shares, 76  
 Railway Mania in Germany, 274  
 Railway Switches, 203  
 Railroads in Egypt, 204  
 Railroad Mania, 138  
 Railway Travelling by Wind, 138  
 Renewal of Applications to Parliament, 274  
 Right of Way across Railways, 138  
 River Tyne, 335  
 Robertson, Mr. Joseph Clinton, his "Exquisite Absurdity," p. 54, and Wrappers of No. 12 and 13  
 ———, his Assertions flatly contradicted by Lord Petre, 200  
 ———, his "Splendid Offices," 273  
 ———, Advertisement, 330  
 Russian, 77, 140, 141, 337, 413  
 Shareholding, 76  
 Sheffield and Manchester, 75, 275, 333  
 South Midland, 138  
 South-Western, 139  
 South-Eastern-Dover, 72, 135, 275  
 Southampton, 76, 139, 203, 236, 275, 409  
 Standing Order Committee, 335, 410  
 Steam-engines and Railroads, 136  
 South Union, Manchester, Chester, and Staffordshire, 410  
 Sheffield and Rotherham, 410  
 Tamworth and Rugby, 204  
 Thames Haven, 140, 319  
 Venice and Milan, 274, 336  
 Victoria Bridge, 335  
 Ulster, 411  
 Warburton's Report, 411  
 ——— and the Railways, 411  
 Watertown and Cape Vincent, 336  
 Westminster Bridge, Deptford, and Greenwich, 275  
 Whitehaven, Maryport, and Carlisle, 204  
 Whitby and Pickering, 140  
 York and North Midland, 234, 275





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